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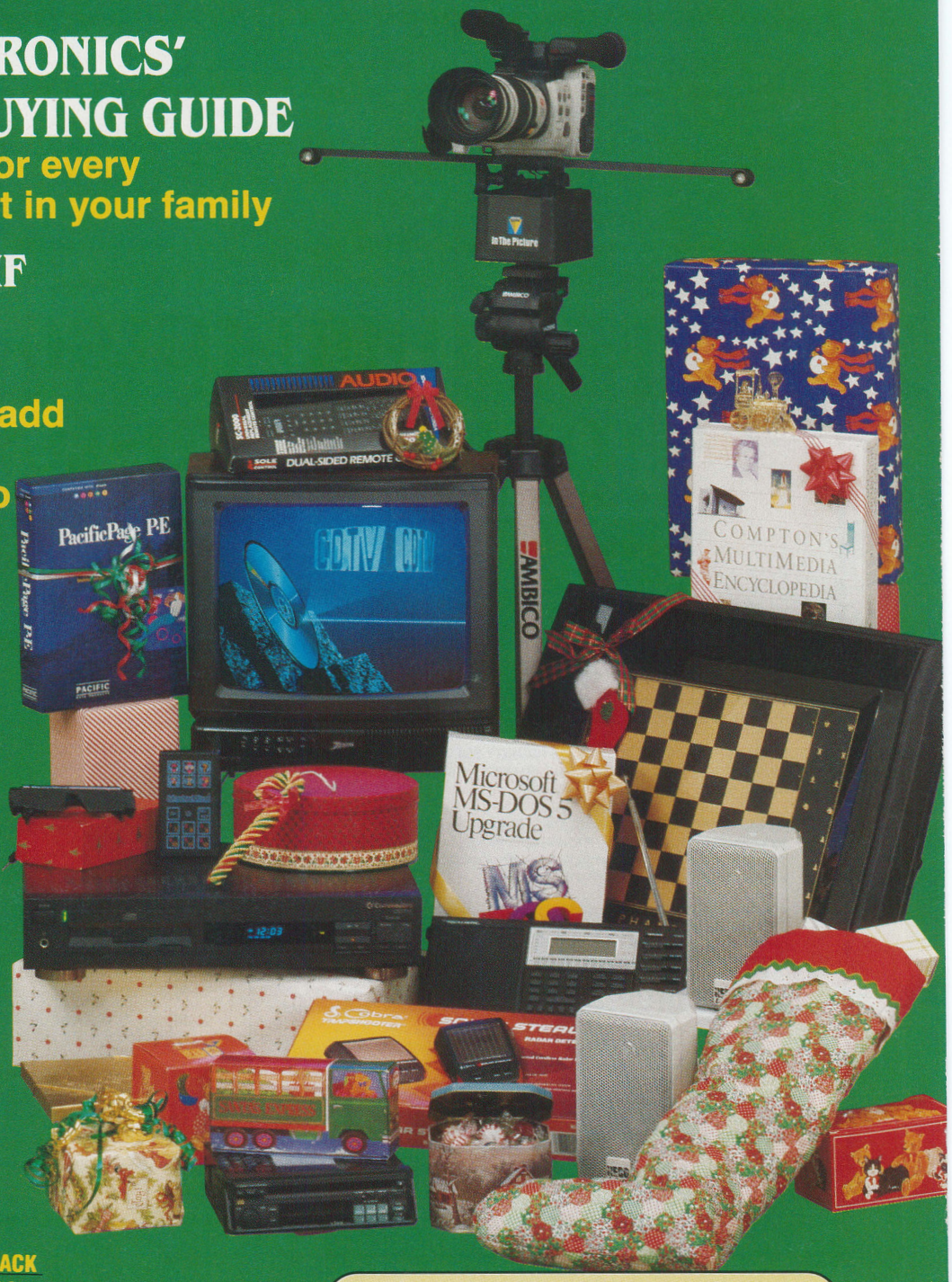
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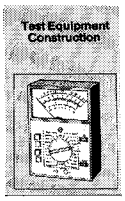
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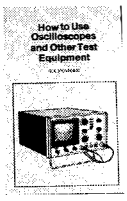
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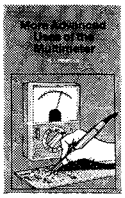


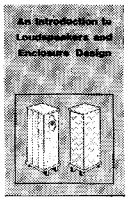
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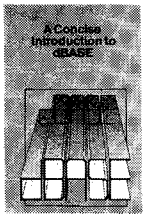
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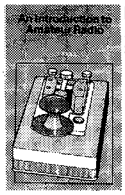




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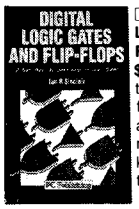




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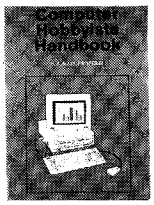


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EDITORIAL

PEACE ON EARTH

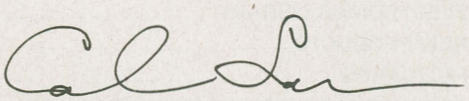
In the space of little more than a week, nearly 75 years of Communist rule was swept away in the Soviet Union. This second Russian revolution was made possible by the courage of the people in that country, but it is important to recognize the role that technology played, and how things might have been different if the coup leaders had realized the many paths of communications now available to their country's citizens.

By failing at first to completely control their nation's electronic media, the coup leaders allowed the country to see the acts of defiance at the Russian Parliament of Boris Yeltsen, and others. Eventually, of course, most of the TV and radio stations, as well as the print media, were either silenced or brought into line.

However, an underground electronic network of fax machines and computer bulletin boards, which allowed uncensored news and information to speed across the country and around the world, was never silenced. Those continued to operate throughout the coup, and helped rally the opposition that eventually caused it to fail.

As this is being written, the Soviet Union as we've known it has apparently ceased to exist. The form and character of the entity or entities that replace it is still to be determined. Because of that, and because of the power vacuum that now exists, these may be among the most dangerous times in the history of the World.

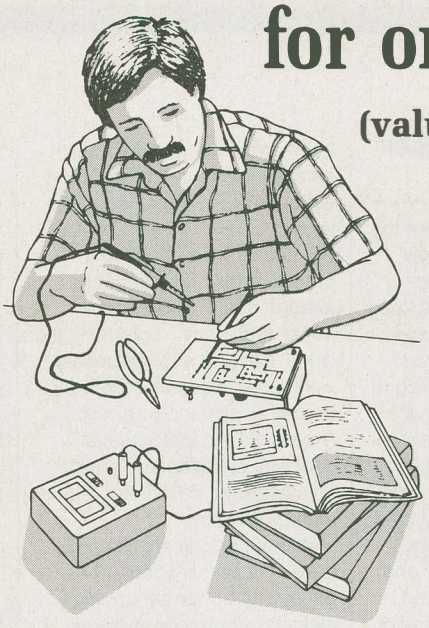
However, these are also exciting and hopeful times. While we can't be sure how events will ultimately play out, there is at least a chance that mankind's dreams of "Peace on Earth" may be a little closer to coming true. As we enter this holiday season, I can't think of a better gift for all of humanity.

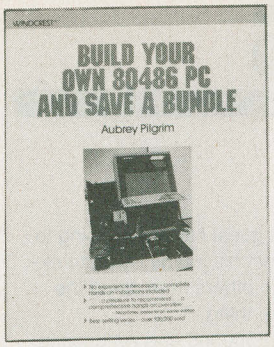


Carl Laron
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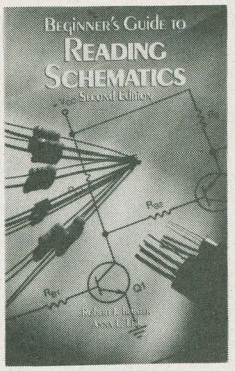
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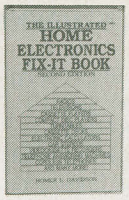




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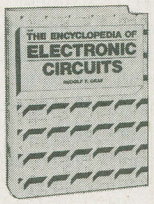
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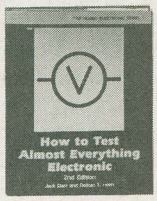
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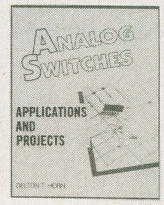
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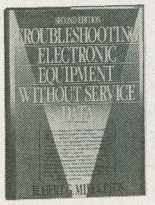
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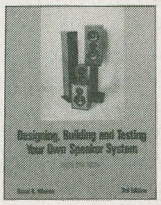
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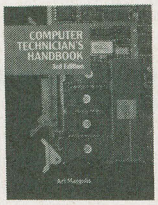
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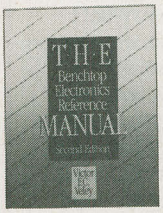


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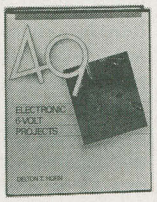


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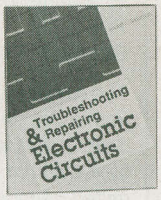
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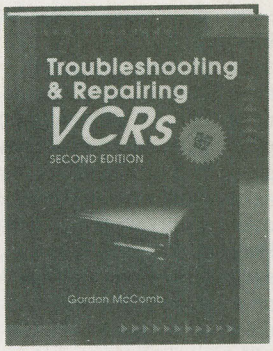
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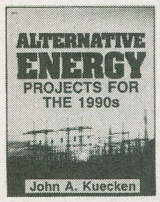
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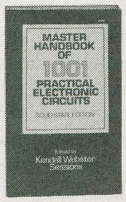
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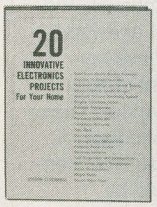
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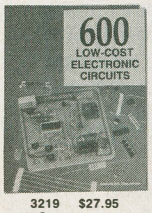
3485 $27.95
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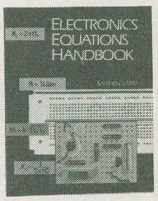


2613P $17.95

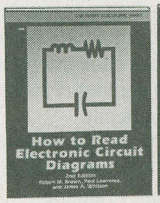
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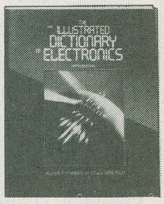
3321P $16.95



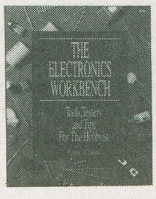
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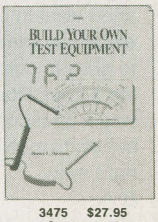
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LETTERS

A HAPPY E.E. STUDENT

I am an Electrical Engineering student in my senior year. I would like to thank Harry L. Trietley for his fine article titled "What Do Electrical Engineers Do?" (**Popular Electronics**, September 1991). That article gave me a better understanding of what I might be doing as an engineer. It also helped me to choose the department where I would prefer to work (design, production, research, etc.). I feel that every E.E. student should read the article. It gave a very clear picture of what's coming after college. A very instructive article, indeed.
P.N.
Bronx, NY

AN UNHAPPY SUBSCRIBER

I have just received my first subscription issue of **Popular Electronics** (September 1991), and I am already disgusted by the amount of space devoted to computers. If I had wanted computer information, I would have subscribed to a computer magazine instead. In the *Letters* column, you promised A.L.M of Honolulu that you would not expand computer coverage. Yet on page 26, there's a feature article on the Macintosh. Get with it on electronics—not computers, please!
W.T.G.
Baton Rouge, LA

AND...A HAPPY NEW SUBSCRIBER

I recently discovered **Popular Electronics** and was immediately drawn to it, especially because of the simple layman's language used. Although I have no formal science background, I understood the content of most of the articles perfectly.

At present, I work at a television station as a presenter and producer. I recently had the urge to get behind the camera, and I want to understand the electronic intricacies. I also want to get into computers. So coming across **Popular Electronics** was a godsend. I intend to start subscribing to your magazine right away.
B.A.
Ogun State, Nigeria

NOT-SO-SIMPLE LASER POWER SUPPLY

Looking at the schematic for the "Simple Laser Power Supply" (**Popular Electronics**, September 1991), there seems to be something missing. What supplies base drive to the power transistor (Q2)? I see nothing to do that in either the schematic or the PC-board layout. Thinking that perhaps I was missing something, I built the PC board and circuit anyway. When I tried the board combined with the coil, there was no "whine," and looking with a scope showed, as I suspected, that the base of Q2 was not toggling. To fix the circuit I put a 330-ohm resistor from +6V to the base of Q2. That made the supply operate as advertised.
T.M.
Sherman, TX

The circuit as published suffers from a design error. However, despite that, an assembly error by the author allowed the submitted prototype to work; the 2N2222 (Q1) was installed backwards, an error that was carried through to the parts-placement guide. When Q1 is installed that way, Q2 is driven directly by the 555 through Q1's base-emitter junction. Assuming Q1 is installed correctly (as shown in the schematic), your fix is one of several that will allow proper operation. You could also eliminate Q1 altogether and tie the R3/C3 junction directly to Q2's base. We apologize for any inconvenience this error has caused.—Editor

TAKING THE INITIATIVE

A letter called "Electro Guard Installation" (**Popular Electronics**, September 1991) really made me angry. The idea that it takes some sort of credential to install a domestic fuse box or attachments thereto is ludicrous. Where would we be today if Bell, Edison, Westinghouse, Edgerton, etc. had been afraid to cremate a few pieces of wire or explode a few cans, or were stupid enough to do so? Edison went so far as to burn down his work shop in pursuit of his dreams, but he learned and profited from it. There aren't any "experts" in the world. There are some people with horse sense and the brains to read books and instructions. A sensible technologist can deal with anything and will do so successfully. Success is a matter of vision.

Without significant training, I have successfully dealt with projects in power-generating stations, steam power plants (chemical), manufacturing, transportation, agriculture, military, aviation, etc., at the technical, engineering, and management levels. What I have accomplished, *anyone* can accomplish if he will put his head to it. My IQ is only average, but I don't admit any limits to profitable effort. I saw a kid put together a one-chip heart monitor as soon as op-amps came on the market. I saw hand-built lasers almost as soon as I saw laser literature. There are multitudes of technicians out there who do wonders putting together gadgets that are amazing and useful. The one thing that none of them needs is a paper that says that they are "qualified" to do something. Accomplishment is its own certification.

Across technology we have a plethora of standards and codes to guide people and enhance safety. It is good for specialized technicians to memorize them. It is just as good for the generalist to follow the standard code as needed. It has been my experience that specialists screw up as often as generalists. And specialists often get frozen out of the job market where broader technicians prevail.

No one should think that any technical subset is any more than a tool, a means to an end. The "end" of any project is just a tool for the next project. And on it goes! No one is going to protect his job by trying to exclude others from doing the same thing.

Europeans and Americans used to have a corner on advanced technology, but now other people around the world are making gadgets of the highest technologies (and making more money than we are). Heads up and eyes forward, America—we are losing an important race.
R.C.G.
Aurora, IL

SERVICE MANUAL SOURCE

I often see letters in **Popular Electronics** from readers seeking service manuals for assorted electronic gear. Manuals are available from Sams Photofacts, as I'm sure many readers know, but they are expensive and you must accept other material along with each photo fact. However, not many readers are aware of Hi-Manuals in Council Bluffs, Iowa. Hi-Manuals covers only what you need in a service manual. The copies are like new and very reasonable. They have an amazing assortment of hundreds of service manuals, many of which are long obsolete. A listing of available service manuals can be obtained by sending $1.00 shipping and handling to Hi-Manuals, P.O. Box 802, Council Bluffs, IA 51502.
K.K.
Temperance, MI

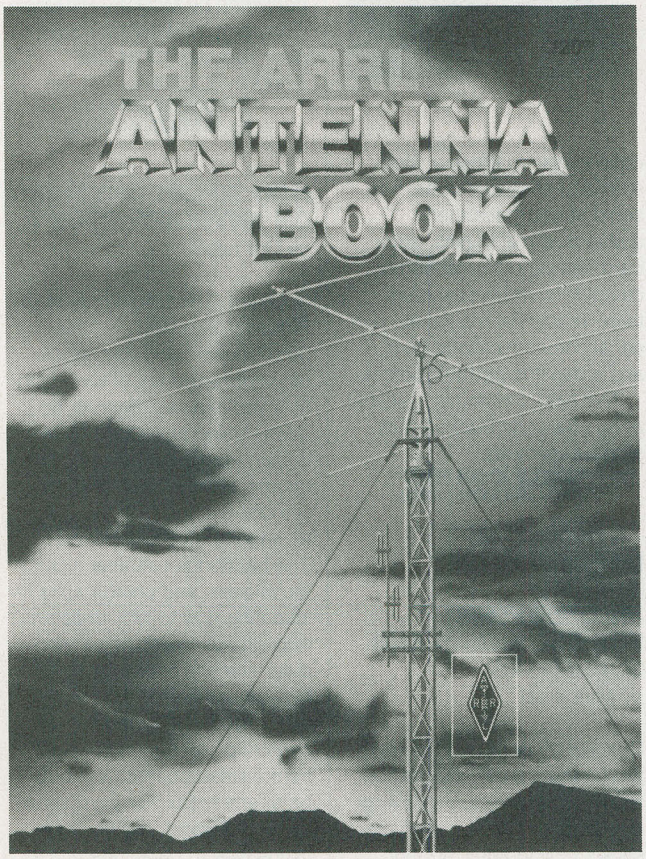
HAVES AND NEEDS

I have a 1958 Wollensak stereo tape magnetic recorder (model T-1515, Serial Number 103460), for which I have the schematic, but no owner's manual. If anyone can help me locate a manual, I'd be very grateful.
Mike Daley Jr.
36 North Shore Avenue
Danvers, MA 01923 ■

ELECTRONICS LIBRARY

The ARRL Antenna Book

edited by Gerald Hall, K1TD



This is the 16th edition of an American Radio Relay League (ARRL) book that first appeared in print in September of 1939. Dedicated to providing more and better information about radio antennas, for decades now the book has been popular with both amateurs and professionals. The newest edition contains some of the drawings that accompanied tutorials back in the original, along with a wealth of updated information on antenna design and radiation patterns that's based on computer analysis. This edition also contains an expanded chapter on antenna and transmission-line measurements, and other new material appears throughout its 28 chapters and 736 pages.

The comprehensive book covers virtually every type—mobile and maritime, space-communications, long-wire, traveling-wave, loop, multiband, multielement, broadband, log-periodic, direction-finding, quad arrays, yagi arrays, and portable—of antenna. The basic information needed to understand how antennas work is provided in chapters on fundamental theory, and radio-wave propagation and the Earth's effect on it. Practical advice and information needed to set up antenna systems is presented in chapters on safety, selecting a system, materials and accessories, product suppliers, antenna supports, coupling the transmitter to the line and the line to the antenna, measurements, and Smith Chart (a tool for solving transmission-line problems) calculations. The appendix includes a glossary of terms, definitions of commonly used abbreviations, conversion tables for length measurements, and metric equivalents. A 14-page index helps readers locate material quickly.

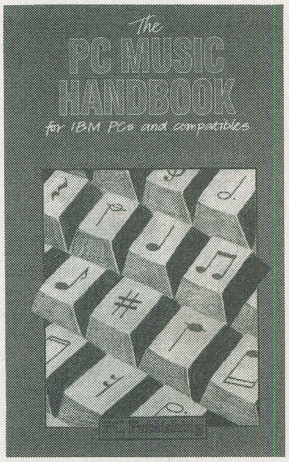
The ARRL Antenna Book costs $20.00 and is published by the American Radio Relay League, 225 Main Street, Newington, CT 06111.

CIRCLE 89 ON FREE INFORMATION CARD

THE PC MUSIC HANDBOOK: For IBM PC's and Compatibles

by Brian Heywood and Roger Evan

The personal computing power of the popular IBM PC and compatibles has brought the possibilities of computer music within the budget of most amateur and professional musicians. This book leads you through the creative possibilities of the PC and acts as a guide in selecting both hardware and software for making music. Aimed at professional musicians, talented amateurs, and curious hobbyists, the book explains the basics of computer music and covers what is currently available in terms of both hardware and software. It explains sequencing, sampling, and notation, and describes just how the PC fits into the music studio. Full of practical tips, the book provides guidelines for programming musical applications, warns of common pitfalls to be avoided, and suggests a number of setups that could bring out the best of your particular musical abilities. Appendices include discussions of MIDI specifications and online communications and listings of addresses of industry contacts, a glossary of related terms, and suggested readings.



The PC Music Handbook (order number PCP113) costs $17.45 (including shipping and handling) and is published by Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.

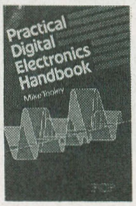
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features a new product line: a line of video products, including camcorders, VCR's, and TV's, all carrying the respected Memorex brand name. New product highlights include a new 13-inch color TV/VCR combination and a new satellite receiver, both from Memorex. For school and business use, the catalog describes a variety of calculators, pocket data organizers, and spelling checkers. Of particular interest this year are an outgoing telephone-call restrictor and several install-it-yourself automotive alarm systems. The



catalog also features a wide selection of headphones, personal stereos, scanners, automotive electronics, standard and cellular telephones, computers and accessories, three TandyFAX machines, personal communications gear, and a desktop/portable copier.

The 1992 Catalog is available at no charge at Radio Shack stores nationwide.

CIRCLE 90 ON FREE INFORMATION CARD

HANDBOOK OF APPLIED MATHEMATICS FOR ENGINEERS AND SCIENTISTS

by Max Kurtz

Specifically designed to meet the on-the-job requirements of today's computer-oriented engineers and scientists, this book shows how to apply current mathematical techniques to a wide range of engineering and scientific problems. The comprehensive book not only presents the definitions, basic equations, principles, and techniques of mathematics, but also illustrates their applications with more than 300 solved examples. Covering everything from elementary algebra through trigonometry to advanced calculus, the book is filled with important information on both the structure and dynamics of mathematics. Emphasizing the need to develop analytical skills when applying mathematics, the book offers an integrated treatment of the different subjects covered. Major sections are devoted to such subjects as plane and solid analytic geometry, matrix algebra, statistical inference, regression analysis, Boolean algebra, permutations and combinations, the transformation of space in computer graphics, Markov probability, and cybernetics. Numerous graphs, tables, and diagrams accompany the text to help clarify the complex relationships of various components.

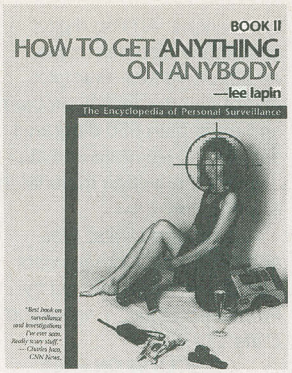
Handbook of Applied Mathematics for Engineers and Scientists costs $69.95 and is published by McGraw-Hill Book Company, 11 West 19th Street, New York, NY 10011; Tel. 1-800-2-MCGRAW.

CIRCLE 96 ON FREE INFORMATION CARD

HOW TO GET ANYTHING ON ANYBODY: BOOK II

by Lee Lapin

Subtitled "The Encyclopedia of Personal Surveillance," this book shows how nosy people get information about you—and how you can stop them or do it back—using a plethora of information from government agents, private detectives, police officers, the FBI, the CIA, engineers, and researchers. The handbook contains tricks, techniques, and photographs illustrating how to look or listen through solid walls, read computer screens from a distance, bypass passwords, obtain unlisted telephone numbers, tail a person, protect any phone call from eavesdroppers, and bugproof any room. For those who are on a budget, the book explains how to obtain the latest government-level surveillance gear at low prices, see in the dark with inexpensive star-light scopes, and duplicate $5000 law-enforcement video systems for a couple of hundred dollars. Information for armchair adventurers includes how to put together a complete dossier on



anyone from the comfort of home by accessing hundreds of new data bases that trace, track, and provide Social Security numbers, addresses, phone numbers, credit histories, motor vehicle records, real property, marriage, death, divorce, and legal information, as well as forwarding addresses and new reports, on anybody. The book describes the equipment used to snoop, and provides a list of sources for that equipment.

How to Get Anything on Anybody: Book II is available for $38.00 (plus 8% sales tax in California) from ISECO, Inc., 2228 South El Camino Real #349, San Mateo, CA 94403; Voice Mail: 415-513-5549.

CIRCLE 91 ON FREE INFORMATION CARD

ADVANCED ROBOTICS: REDUNDANCY AND OPTIMIZATION

by Yoshihiko Nakamura

With an emphasis on the mathematical and theoretical approach, this book covers recent theoretical advances related to the kinematics and dynamics of robot mechanisms that are often not mentioned in other books. It explains the efficient-computation method and other topics related to advanced control schemes.

To provide machines with autonomy and dexterity, the next generation of robots must be equipped with more actuators and sensors. That is the basis of the field of redundancy, on which this focuses. Specific research on kinematics, dynamics, control, and sensing generally has been done in an isolated manner, but their common features are found in the mathematical techniques to optimize or utilize redundancy that are presented in this book. Aimed at graduate students, researchers, and practicing engineers, the book establishes a comprehensive methodological perspective for the mathematical optimization techniques used in the field.

Advanced Robotics: Redundancy and Optimization costs $65.75 and is published by Addison-Wesley Publishing Company, Reading, MA 01867; Tel: 617-944-3700.

CIRCLE 92 ON FREE INFORMATION CARD

NEW NO-CODE TECHNICIAN CLASS HANDBOOK

by Gordon West

For those who wish to become licensed ham-radio operators under the new No-Code Technician Class rules (which do not require the traditional Morse code test), this book contains the latest questions from the FCC's element 2 and element 3A question pools. To make the material quick and easy to learn, the correct answers are listed after the possible choices, and detailed information is provided on the same page. Besides the official FCC questions and answers, the book includes information and charts describing the Amateur Radio Service and its privileges for the new No-Code Technician Class. In addition, there is information on where the exam is offered and how to complete FCC Form 610 (Application for Amateur Radio Station/Operator License), which is bound in the back of the book.

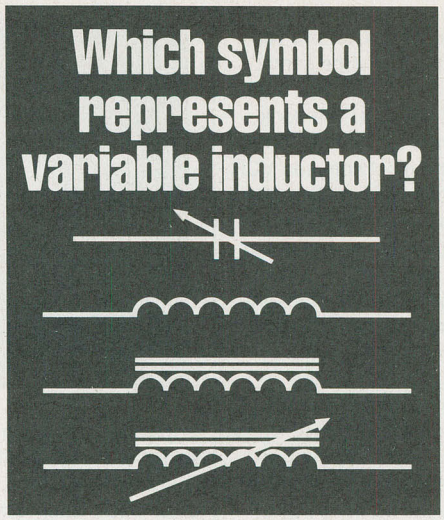
The New No-Code Technician Class Handbook is published by Master Publishing and sells for $9.95 at Radio Shack stores nationwide.

CIRCLE 93 ON FREE INFORMATION CARD

HOME VCR REPAIR ILLUSTRATED

by Richard C. Wilkins & Cheryl A. Hubbard

Most VCR problems are not difficult to fix—in fact, many involve replacing or repairing only one part. Yet service shops charge a lot of money to make those repairs. This book, written by an electronics service technician who has owned two



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CIRCLE 5 ON FREE INFORMATION CARD

VCR-repair shops, shows you how you can make the same repairs at home—for less than a fraction of the cost. The book explains how to find and correct many of the most common VCR malfunctions, such as jammed videocassettes, clogged video heads, blown fuses, and water damage. Trade secrets are revealed for repairing problems with picture and sound quality, fast forward and rewind, DC motors, tension and roller guides, undercarriages, take-up spindles, remote controls, audio heads, and more. No specialized test equipment is required; all repairs can be done using household items and common tools. One chapter is devoted to diagnostics, and most chapters have a review section that provides step-by-step instruction to assist in diagnosing and repairing the part of the VCR that is discussed in the chapter. The book includes many detailed, high-quality photographs that help illustrate the written instructions, and a glossary that defines specialized VCR terminology.

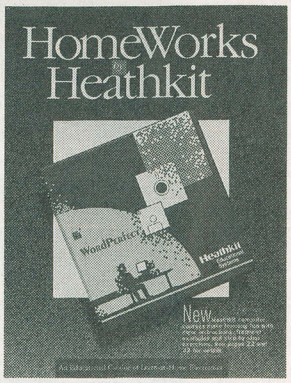
Home VCR Repair Illustrated costs $19.95 and is published by TAB Books, Division of McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850; Tel. 1-800-822-8138.

CIRCLE 101 ON FREE INFORMATION CARD

HOMEWORKS BY HEATHKIT

from Heath Company

The Fall 1991 issue of *Homeworks by Heathkit* introduces five new computer courses that offer a fast, easy way to gain a working knowledge of computer applications and include WordPerfect, Windows, Lotus 1-2-3, Word for Windows, and AutoCAD. The courses provide easy-to-read text and step-by-step instructions—plus frequent examples, illustrations, and helpful tips. The catalog also introduces six new home-study video courses that can be used to learn important electronics concepts. The topics include op-amps, linear power supplies, switching power supplies, troubleshooting with oscilloscopes, troubleshooting with electronic test equipment, and troubleshooting microprocessors. A student workbook



is included with each video. In addition, the catalog features courses in basic and advanced electronics, laser technology, digital techniques, fiber optics, surface-mount technology, data communications, microprocessors, and other subjects. A variety of Heathkit trainers and trainer accessories, which are used in performing the course experiments, are offered in both kit and assembled form. Each time a student completes a Heath course and passes the optional final exam, Continuing Education Units, which are recognized as job-related certification by many professional and technical organizations, are awarded.

The Fall 1991 HomeWorks by Heathkit Catalog is free upon request from Heath Company, Department 350-057, Benton Harbor, MI 49022; Tel: 1-800-44-HEATH.

CIRCLE 100 ON FREE INFORMATION CARD

THE HOME SATELLITE TV INSTALLATION AND TROUBLESHOOTING MANUAL; Revised 3rd Edition

by Frank Baylin with Brent Gale and Ron Long

Written for those who install satellite TV systems for a living—and for satellite dish owners who want to know how to set up their systems and keep them running smoothly—this 326-page book is written in a clear, concise style, easily understood by the layman. The book includes background theory and detailed information on how satellites and TVRO's work. It describes methods of judging and selecting satellite TV components, and provides comprehensive step-by-step instructions—accompanied by all necessary charts, tables, diagrams, and illustrations—for multiple-receiver and multiple-television setups. The book also covers how to install extra-large antennas. A complete strategy of troubleshooting any satellite TV system is offered. The revised version contains two new chapters on small dish systems and upgrading an existing system. The appendix includes a collection of useful equations, a glossary, and reference books and magazines, and a complete list of satellite-equipment manufacturers.

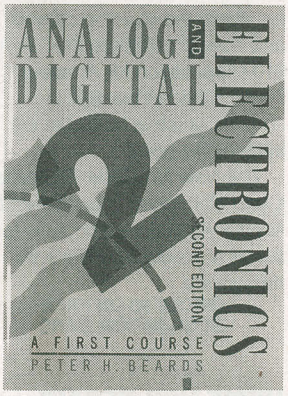
The Home Satellite TV Installation and Troubleshooting Manual is available for $30 plus $3 for shipping and handling from Baylin Publications, 1905 Mariposa, Boulder, CO 80302.

CIRCLE 98 ON FREE INFORMATION CARD

ANALOG AND DIGITAL ELECTRONICS A First Course: Second Edition

by Peter H. Beards

This book is written to provide a single text that covers, in broad terms, the foundation in electronics needed for an electrical/electronic engineering degree course. It offers broad and balanced coverage of both analog and digital electronics, covering



all important and up-to-date topics taught in first- and second-year undergraduate engineering courses today. The book covers the analysis and design of discrete and integrated analog circuits, and provides an introduction to combinational and sequential logic. The second edition includes an entirely new chapter on the 16-bit microprocessor, its operation, and applications. Analog/digital interfacing is also discussed. A wealth of worked examples, end-of-chapter review problems, and more than 650 diagrams are used to illustrate and supplement the written material that is presented.

Analog and Digital Electronics; A First Course costs $58.00, and is published by Prentice-Hall Inc., Englewood Cliffs, NJ 07632.

CIRCLE 99 ON FREE INFORMATION CARD

ELECTRONIC PACKAGING AND INTERCONNECTION HANDBOOK

by Charles A. Harper

Featuring in-depth information on all aspects of the rapidly evolving technology of electronic packaging and interconnections, this book fully explains the design, manufacture, and application functions. More than 20 specialists in the field contributed articles in their areas of expertise. Those articles tell how to select the most effective plastics, ceramics, and metals; describe how to minimize heat problems in increasingly dense electronic assemblies; and focus on the design of both rigid and flexible printed/wiring boards. Reflecting the interdisciplinary nature of the technology, the articles connect relevant material from the areas of materials science, electronics, and mechanical design. The book provides detailed guidelines on the parameters (electrical, mechanical, and material) of the IC's and semiconductor devices used in packaging and interconnections. Other subjects that are covered in the book include the materials for electronic packaging, the packaging of high-speed digital electronic systems, soldering and solder-paste technology, hybrid microelectronic packaging, the wiring and cabling involved, computer-aided design systems, and more.

Electronic Packaging and Interconnections costs $79.50 and is published by McGraw-Hill Book Company, 11 West 19th Street, New York, NY 10011; Tel. 1-800-2-MCGRAW. ■

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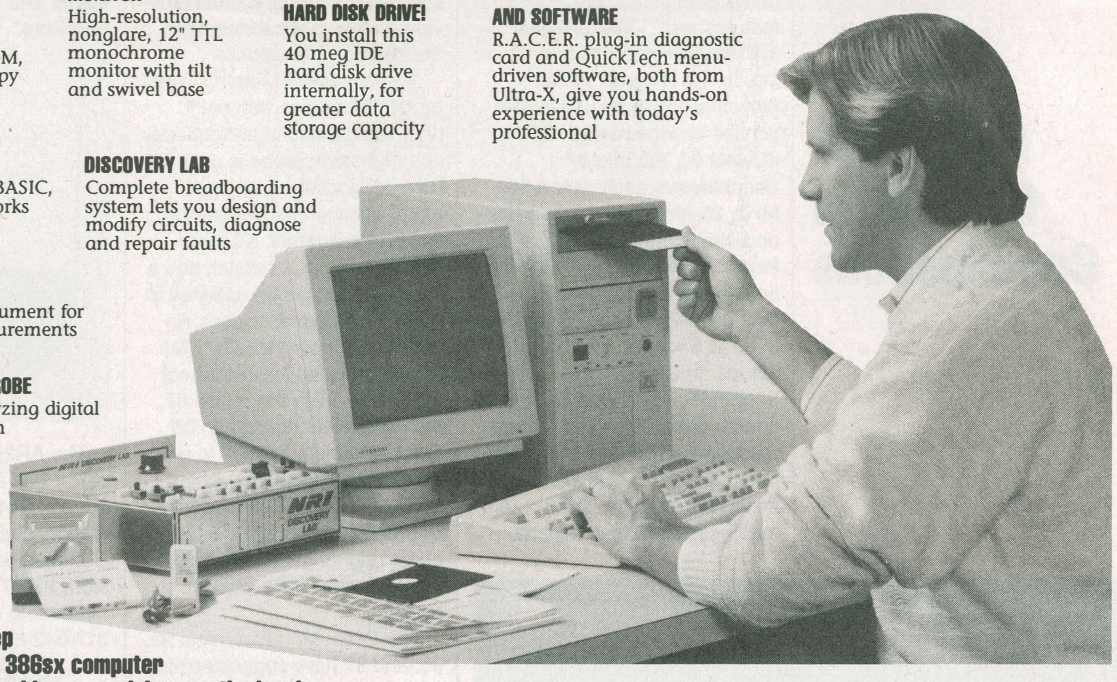
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LESSONS
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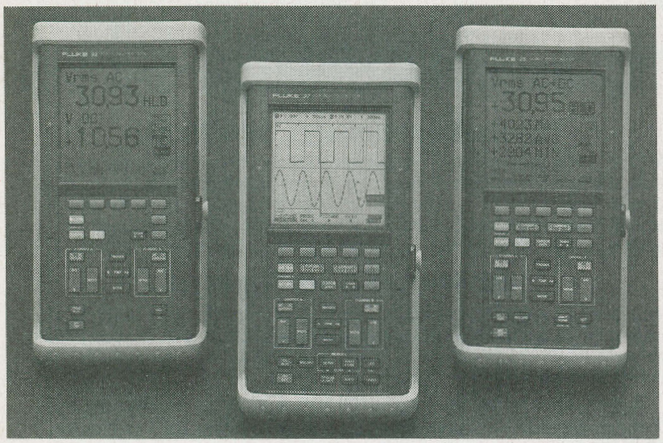
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NEW PRODUCTS

Hand-Held DSO/DMM Combinations

Three handheld test instruments developed jointly by *Fluke* and *Philips*, combine sophisticated oscilloscope features with powerful digital multimeter functions, constructed in rugged, sealed industrial cases for use in field-service environments. The *models 93, 95, and 97 ScopeMeters* each offer a 50-MHz, 25-megasamples-per-second, dual-channel DSO that features a 40-ns glitch-capture time to catch intermittent failures, and storage capabilities of up to 8 waveforms and ten setups. In addition, the ScopeMeters provide such multimeter capabilities as Min-Max recording, which provide simultaneous display of maximum, minimum, average, and present readings; diode test; relative



and percent-relative modes; dBm, dBV, and dBW readings; touch hold; and autoranging. Using the included probes, the instruments can make floating high-voltage measurements to 600 volts RMS.

Features such as "Autoset," waveform and set-up memory, combined display of meter results and waveforms, menus, and softkeys simplify operation. In oscilloscope mode, "autoset" automatically sets volts per division, time per division, position, and triggering controls for every input signal. In the meter mode, autoset automatically tracks the input signal for the proper range, time-per-division display, and triggering. Five softkeys allow the user to easily find and select different functions of the instrument. Pop-up menus provide a clear guide through the ScopeMeter's functions.

All three ScopeMeters include probes that come with both high-voltage and high-frequency tips (the same probe is used for both oscilloscope and multimeter voltage measurements), an AC line adapter, a built-in battery charger, a holster, and a tilt stand that can be adjusted to hang over a panel or door. An optically isolated RS-232 interface is provided for instrument calibration. With the model 97, the RS232C interface can be used for remote control, to read waveforms and setups, or to print the display. The model 97 ScopeMeter also features a built-in signal generator, a component tester, and a backlit display.

The ScopeMeters models 93, 95, and 97 have suggested list prices of $995, $1295, and $1597, respectively. For more information, contact John Fluke Mfg. Co., Inc., P.O. Box 9090, Everett, WA 98206.

CIRCLE 103 ON FREE INFORMATION CARD

1000-CHANNEL SCANNER

With frequency coverage from 500 kHz to 1300 MHz, *Ace Communications' AR2800* mobile/base receiver allows reception of all broadcast bands, shortwave frequencies, military-communications bands, public-service bands, single sideband, and TV audio. A total of 1000 scan-memory channels can be programmed using 26 front-panel keys, and upper and lower limits for bands to be searched can be stored in ten separate memory locations. The AR2800 also features a selectable priority channel, and keyboard lockout. The backlit display offers 21 different prompts to help you use the unit easily. The compact unit measures 2¼ × 5¾ × 7¼ inches, weighs only 12 ounces, and comes with an AC adaptor/charger, a DC power cord, a telescoping antenna, a desk stand, and mobile mounting hardware.

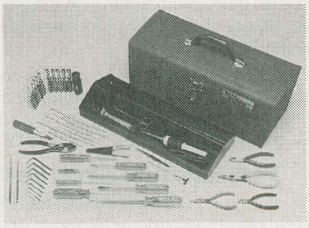


The AR2800 mobile/base receiver has a suggested retail price of $449. For more information, contact Ace Communications Monitor Division, 10707 East 106th Street, Fishers, In 46038; Tel: 317-842-8794.

CIRCLE 104 ON FREE INFORMATION CARD

ELECTRONICS TOOL KIT

Jensen's JTK-2 kit contains a selection of tools for basic electronic maintenance tasks in the plant or shop. It includes 43 tools needed for electronic assembly and repair, packed in a heavy-duty steel box with a removable tray. The brown enamel toolbox measures 16 × 7½ × 7½ inches has a latch and padlock eye for secure closing.



The JTK-2 electronics tool kit costs $169.95. For additional information, contact Jensen Tools Inc., 7815 South 46th Street, Phoenix, AZ 85044; Tel: 602-968-6231.

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LOW-PASS FILTER

Designed to reduce television interference (TVI) caused by harmonics and spurious signals that may be generated by your HF rig, the *MFJ-704* low pass filter provides attenuation to frequencies above 40 MHz using a



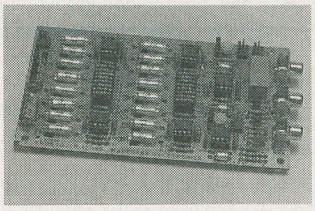
proven nine-pole Chebyshev low-pass filter design. The low-pass filter handles a full 1500 watts of power with low SWR, and insertion loss is less than 0.5 dB. The compact unit measures 8¾ inches deep by 2¾ inches wide by 3 inches high.

The MFJ-704 low-pass filter costs $39.95. For further information, contact *MFJ Enterprises, Inc.*, P.O. Box 494, Mississippi State, MS 39762; Tel: 601-323-5869 (800-647-1800 for orders only); Fax: 601-323-6551.

CIRCLE 106 ON FREE INFORMATION CARD

CROSSOVER KIT

Aimed at serious audio enthusiasts (and electronics hobbyists), the *XM-16 electronic crossover network* from *Marchand Electronics* has an eight-order design that results in clean cut-off when dividing the audio



spectrum between tweeters, mid-range, woofers, and subwoofers. Available as a D-I-Y kit, or fully assembled, the circuit incorporates a two-section, four-stage filter network with pre- and post-amplification and ambient-signal protection during startup and shutoff. Each audio channel will require its own XM-16. The precise crossover frequency can be set between 20 Hz and 5 kHz using plug-in frequency modules, making it easy to select the right crossover frequency for your system. Signal-to-noise ratio is better than 110 dB, and harmonic distortion at 1 kHz is less than 0.001%. The output level controls are included on the board, but the optional XM-16 PT, a remote cable, connector, and potentiometer assembly, can be used to relocate those controls to your control panel. The kit includes top-quality components, a 3.2 × 5.8-inch double-sided PC board with plated-through holes that includes a ground plane for exceptional audio quality, and detailed assembly instructions and circuit description.

The XM-16 crossover network costs $59.95 in kit form (*XM-16-K*) and $79.95 assembled and ready for installation (*XM-16-A*). For additional information, contact Marchand Electronics Inc., 1334 Robin Hood Lane, Webster, NY 14580; Tel: 716-265-4930.

CIRCLE 107 ON FREE INFORMATION CARD

BNC CABLE ASSEMBLIES

The *2249 Series* of BNC cable assemblies from *Pomona* feature extra-long, stress-relieved PVC boots molded directly onto the cable jacket and connector body. That design has the advantages of stress protection to prevent failure from excessive bending, flexing, and twisting, and weather-resistant seals between the cable and connector. The cable assemblies are available in four RF cable categories: The 50-ohm RG58C/U has a 4.95 mm (0.195-inch) outside dimension; the 75-ohm RG59B/U has a 6.15-mm (0.242-inch) outside dimension; the 50-ohm RG174/U has a 2.54-mm (0.100-inch) outside dimension; and the 93-ohm RG62A/U, 6.15-mm (0.242-inch). Cable ends in all four categories are identical. They feature crimp BNC male connectors with tarnish-resistant, gold-plated brass center contacts and molded, black PVC boots. The cable assemblies have a maximum operating voltage of 500-volts RMS at 50 °C (122°F) maximum.

DIGITAL VIDEO STABILIZER ELIMINATES ALL VIDEO COPY PROTECTIONS



While watching rental movies, you will notice annoying periodic color darkening, color shift, unwanted lines, flashing or jagged edges. This is caused by the copy protection jamming signals embedded in the video tape, such as Macrovision copy protection. Digital Video Stabilizer: RXII completely eliminates all copy protections and jamming signals and brings you crystal clear pictures.

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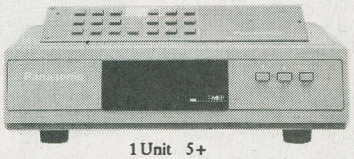
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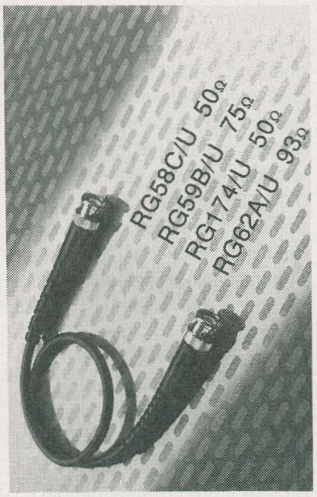


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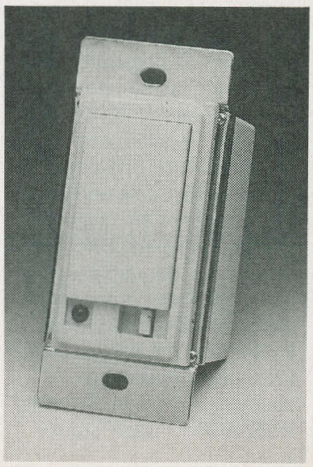


The 2249 Series of cable assemblies, in 1–9-piece quantities, range in price from $9.90 to $19.00. For more information, contact ITT Pomona, 1500 East Ninth Street, P.O. Box 2767, Pomona, CA 91769-2767; Tel: 714-623-3463; Fax: 714-629-3317.

CIRCLE 108 ON FREE INFORMATION CARD

AUTOMATIC LIGHTS-OFF SWITCH

For those who are tired of nagging the kids about turning off lights when they leave a room, *Heath-Zenith* has introduced the *SL-6102 Reflex Auto-off Switch*. The switch fits in a standard electrical switch box and requires only the connection of two wires to the existing line. An adjustable timer lets you program the switch to turn lights off from one to 30 minutes after you've left the room. A hidden selector switch is used to set the time control period. Once the switch is installed, you can place any decorative outlet



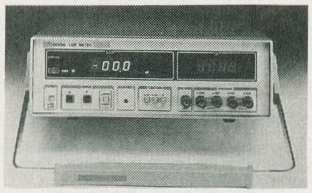
cover over it. Once the switch is activated, the lights begin flashing 24 seconds before turning off. You can keep the lights on continuously by pressing the switch for a slightly longer period of time. The switch controls up to 500 watts of incandescent lighting. It is intended for indoor use only, and cannot be used with three-way circuits.

The model SL-6102 Reflex Auto-Off Switch has a suggested retail price of $12.97. For further information, contact Heath Zenith Reflex Brand Group, 455 Riverview Drive, Benton Harbor, MI 49022.

CIRCLE 109 ON FREE INFORMATION CARD

DIGITAL LCR BRIDGE

For use in production lines, laboratories, research, and circuit-prototype development, *Protek's model B-800* digital LCR bridge measures inductance, capacitance, resistance, and dissipation factors with a high-accuracy 3½-digit display for all parameters to 1999 (maximum). The instrument will automatically select parallel or series equivalent circuitry, and produces rapid response measurements of components and circuits. The model B-800 also has a range changeover for automatic manual modes. It has a 1-kHz (±5%) measuring frequency, a one-second measuring time, and a sampling rate of approximately ten times per second.

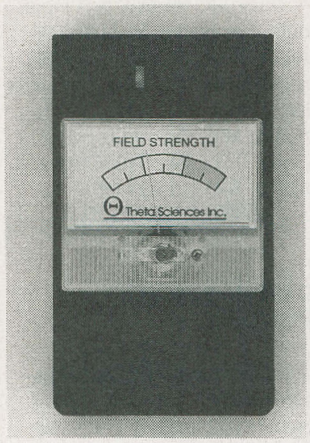


The model B-800 digital LCR bridge, which comes with a two-year warranty, costs $895. For more information, contact Protek, P.O. Box 59, Norwood, NJ 07648; Tel: 201-767-7242; Fax: 201-767-7343.

CIRCLE 110 ON FREE INFORMATION CARD

EMF METER

If you are concerned about the potential health risks that have



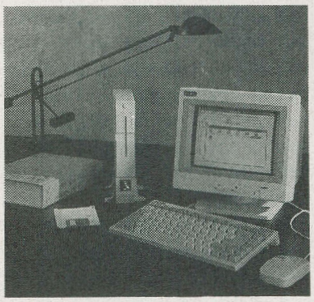
been linked to exposure to low-frequency electromagnetic fields (EMF), *Theta Sciences' HFS-Model IV* field-survey meter can put your mind to rest. It warns you of the locations and strengths of electromagnetic fields in your home and office, and tells you how far away you should keep to be safe. The battery-operated, handheld unit is easy to use to test everything from your alarm clock to your microwave oven.

The HFS-Model IV costs $75.00 plus $3.00 shipping and handling. For additional information, contact Theta Sciences Inc., 11835 Carmel Mountain Road, Suite 1304-413, San Diego, CA 92128.

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ULTRA-SMALL PERSONAL COMPUTERS

Offering full IBM AT and 386SX compatibility in a package no larger than the average hardcover book, *Flytech Technology's Carry-1 9000 Series* of



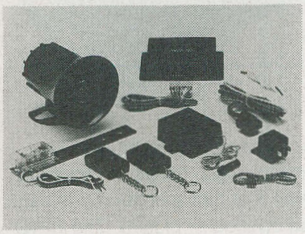
personal computers provide up to 4 megabytes of RAM on the motherboard; a high-density floppy-disk drive; a hard drive ranging up to 80 megabytes in size; and an expansion slot for a half-length modem, networking card, or other customizing expansion card. An optional LAN adapter connects the system to a network through the parallel port. (Two serial ports are also provided.) Each system comes with the Carry-1 mini-keyboard, which has 101-key functionality with only 81 keys. Nine-inch monochrome and nine- and ten-inch color monitors are available options. According to the company, the small-scaled keyboards and monitors make the complete Carry-1 desktop systems the smallest in the industry. Each system comes with a padded carrying case, a mini tower stand, a user's manual, a DR DOS manual, and diskettes.

The Carry-1 9000 Series of book-sized personal computers range in price from $400 for a complete XT-type system with monochrome monitor and one floppy drive to about $3000 for a 386SX Super VGA system with 4 megabytes of RAM and an 80-megabyte internal hard drive. For further information, contact Flytech Technology, 3008 Scott Blvd., Santa Clara, CA 95054.

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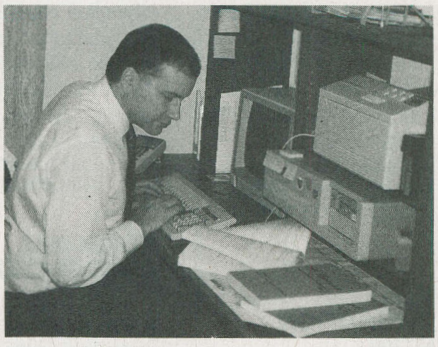
CAR SECURITY SYSTEM

Featuring a compact receiver designed for under seat or dashboard installation, *Black Widow's Series 4* automotive alarm can be armed or disarmed by remote control. When the alarm is set off, the system's



120-dB siren sounds for 45 to 60 seconds, and then automatically resets and continues to monitor all entries. Other features include two remote transmitters with audible chirp, a starter-disable relay, flashing LED status indicators, a manual override switch, power door-lock output, built-in entry-violation memory, a wiring harness with fuse and fuse holder, 360-degree shock sensor, and a glass-

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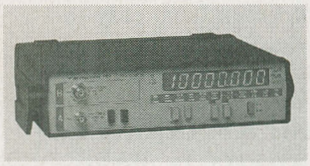
break sensor. The Series 4 can be upgraded by adding one or more of the available options, which include a mass-motion sensor, a power door-lock actuator, a starter disabler, and battery backup.

The Series 4 remote car security system has a suggested retail price of $199.00. For additional information, contact Black Widow Security, 12753 Moore Street, Cerritos, CA 90701; Tel: 213-404-9998; Fax: 213-404-9698.

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1.3-GHz MULTIFUNCTION COUNTER

Particularly well-suited for use in the communications industry, *B&K's model 1856* multifunction counter makes accurate and repeatable measurements of radio-transmitter frequency up to the microwave range and exceeds the FCC standards for adjusting transmitter frequency,



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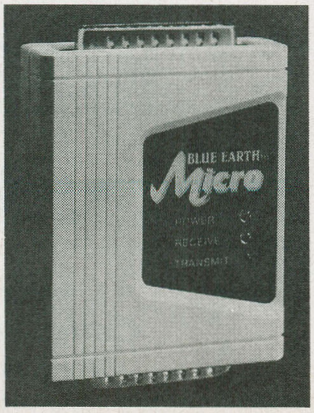
The model 1856 1.3-GHz multifunction counter has a suggested list price of $495. For further information, contact B&K Precision, 6470 West Cortland Street, Chicago, IL 60635; Tel: 312-889-1448.

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PERSONAL CONTROLLER

A tiny, single-board controller from *Blue Earth*, dubbed the *Micro-440* is designed for industrial control, home automation, data-acquisition, and OEM applications. Based on a 12-MHz Intel 83C51FB microcontroller, the Micro-440 can be programmed from a terminal or PC for on-line or remote stand-alone operation. On-chip software allows it to be programmed in either BASIC or 8051 assembly language. In addition to its 16-kilobyte ROM, the device includes 32 kilobytes of battery-backed CMOS static RAM, which can be used store programs, operating parameters, and collected data. A RAM write-protect feature can be used with BASIC file commands to lock in user programs for automatic execution.

The real-time clock/calendar allows event recording or other date- and time-based operations. A total of 14 digital I/O lines can be used to monitor switches and contacts or to drive transistors, relays, etc. Dual RS-232C serial ports allow simultaneous communication with a PC and a printer. An



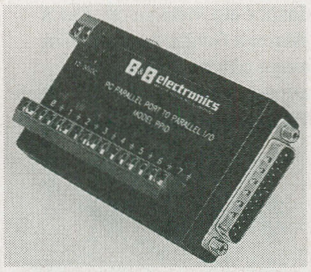
expansion port can be used to add memory or I/O to the base unit. Up to eight analog inputs can be used to read temperature, pressure, or other 0–5-volt sensors. The Micro-440 can be powered from almost any 6–16-volt DC source. A lithium back-up battery maintains the RAM and clock for more than 10 years.

The Micro-440 controller is priced at $199; OEM versions start at $99 in 1000's. A complete system-design package—including the Micro-440, Macro Assembler, Symbolic Debugger and Utilty programs, user manuals (1100 pages), plug-in type DC power supply, an applications module, and PC cable costs $399.

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PARALLEL PORT I/O CONVERTER

You can connect your IBM to the outside world—use it to turn on lights or alarms, or to control relays that can turn on any device—with *B&B Electronics' model PPIO* parallel port input/output converter. The device lets you interface your PC-compatible computer's parallel port to eight discrete inputs or outputs. Any of the eight I/O points can be used to control voltages as high as 50 volts DC with a threshold of 2.5 volts. The input



lines can be used to monitor thermostats, relays, or anything else that has a contact that can be opened or closed. The PPIO comes with complete instructions and sample programs, written in BASIC, Pascal, or C, which can be used to test the device and to display the status of the I/O pins. Parts of those programs can be incorporated into your own programs to make interfacing with the PPIO easier. The sample programs are also intended as learning aids for writing your own code to do a similar job.

The PPIO parallel port input/output converter costs $99.95. A power supply (model 232PS) is available for $14.95. For more information, contact B&B Electronics Mfg. Co., 4000 Baker Road, P.O. Box 1040, Ottawa, IL 61350; Tel: 815-434-0846.

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CAR CASSETTE PLAYER

The *Optimus* AM/FM auto cassette player from *Radio Shack* provides 22 watts of power per channel and features a high-performance digital tuner that assures accurate, drift-free reception. For quickly tuning favorite stations, there are 30 station presets that can be easily sampled using the one-touch memory-scan feature. The auto-reverse cassette player has a metal-tape selector for playing Type IV tapes and built-in Dolby-B noise reduction. The Optimus' loudness control boosts high and low frequencies



when the player is set to low volume levels. Other features include a local/DX signal enhancer for locking onto weak signals, a fader for balancing the front and rear sound levels, line-input/line-output jacks for connecting an additional amplifier or equalizer/booster, a remote-mount CD input terminal with ⅛-inch mini-plug jack for connecting a portable CD player to the system, a noise-suppression choke that reduces or eliminates noise that is caused by the vehicle's electrical system, and a "key-off release" to protect cassette tapes that are left in the player when the car is turned off.

The Optimus AM/FM auto cassette player (Cat. no. 12-1944) retails for $199.95, and is available from Radio Shack stores nationwide. For more information, contact Radio Shack, Division of Tandy Corporation, 700 One Tandy Center, Fort Worth, TX 76102. ■

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THINK TANK

By John J. Yacono

Triacs and Power Control

A while back, I received a letter from someone that had a question about a Triac-operated project that appeared in this magazine. Apparently the sender was concerned that once a Triac was activated, it wouldn't shut off unless the power was cut off. That letter and another (which will appear here this month) prompted this months topic: Triacs and power control. As usual, I'll throw in a circuit with an inventive twist to further illustrate their operation before we get to this month's letters.

Triacs are useful devices because they can switch current on. They are multilayered three-terminal semiconductor devices. The three terminals consist of a gate and two "main terminals" (denoted G, MT1, and MT2, respectively) as shown in Fig. 1. When using Triacs, don't get confused between the two main terminals, they perform entirely different jobs in most circuits. Always remember that MT1 is always illustrated closer to the gate in a schematic.

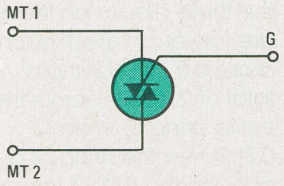


Fig. 1. Triacs are multilayered, three-terminal semiconductor devices. Each terminal has a different function.

To help you to understand how they do their job, take a look at Fig. 2, which is a "characteristic curve" of a Triac. The plot illustrates the relationship between current (I) flowing from one main terminal to the other and the voltage (V) across them. Let's consider quadrant I—the upper right—of the graph first. That's where the conventional current flows from MT2 to MT1, and the voltage at MT2 is more positive then the voltage at MT1.

As you can see, the main terminals do not conduct significant amounts of current until the voltage reaches a certain value called the "breakdown voltage." At that point, the Triac's resistance suddenly drops, allowing current to flow freely with very little voltage drop across the main terminals. The Triac is then said to be "on." As you can see, that behavior forms a "knee-bend" in the characteristic curve. Current will continue to flow in such an uninhibited fashion unless it falls back down into the knee-bend region. The current level at that transition point is called the "holding current" because it is the minimum current needed to hold the Triac on.

If a voltage is applied to make the gate more positive than main-terminal 1, current flows through the gate. The flow of gate current causes a decrease in the value of break-down voltage needed to turn on the Triac. You can increase the gate current to the point where the knee-bend is hardly noticeable. At that point, it only takes a small voltage across the main terminals to turn on the Triac, so the Triac acts like a low-value resistor. That is called "quadrant-I operation."

The same knee-bend behavior can be seen when the polarity of the voltage across the Triac is reversed, which is represented by the lower half of the plot. In that situation, applying voltage to the gate still reduces the break-down voltage, but the gate voltage must be more *negative* than main-terminal 1. As you may have guessed this is called quadrant III operation.

For the sake of simplicity and brevity, I won't discuss quadrant II and quadrant IV operation since not all Triacs can operate in those modes. Suffice it to say that for such operation the gate-voltage polarity will be just the opposite of what it is for the quadrant I and quadrant III modes.

If you use a Triac to control the flow of current in a 60-Hz AC circuit, since the current drops below the holding-current level 120 times a second (*i.e*, during each alternation of the AC line), the Triac must be turned back on 120 times each second.

Furthermore, the gate voltage must be positive with respect to MT1 when MT2 is more positive than MT1, and negative with respect to MT1 when MT2 becomes more negative. That is almost always accomplished by connecting some electrical component or components between MT2 and the gate. That has the effect of pulling the gate voltage toward MT2, and thus away from MT1, providing the necessary potential with the right polarity between the gate and MT1.

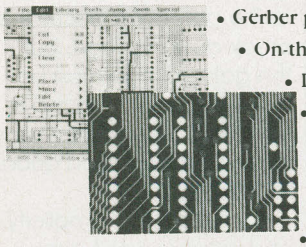
A good example of that technique is shown in Fig. 3. In that circuit, when the LED in the optoisolator receives current it lights up. The light

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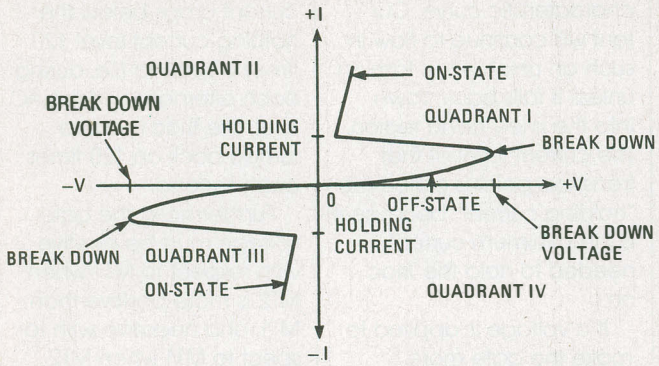


Fig. 2. This is the characteristic curve of a Triac without gate current. It is a plot of the voltage across the main terminals versus the current through them.

it produces reduces the resistance of the photosensitive Triac driver packaged with it. That pulls the voltage of the gate closer to the voltage of MT2, turning on the Triac.

However, there is a way to apply a potential of the right voltage and polarity between MT1 and the gate, without the assistance of MT2. The circuit in Fig. 4 demonstrates the concept. Ignoring R1 for the moment, if a device plugged into SO1 starts to draw current, the current flows through the diode network. Current will flow through one string of three diodes during positive alterations of the AC line, and through the others during negative alternations.

As you probably know, there is a voltage drop across any diode even when it's forward biased. For common rectifying diodes,

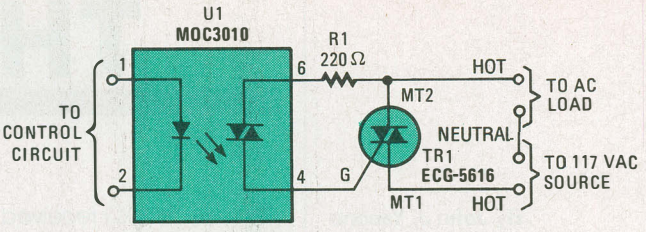


Fig. 3. Triacs can be controlled by low-power circuits through Triac-driver optoisolators as shown here.

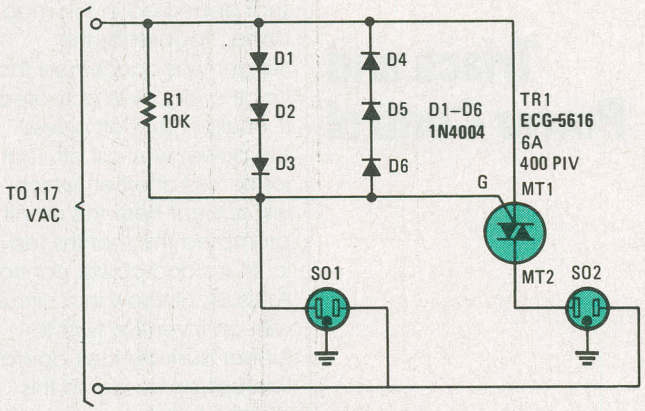


Fig. 4. This circuit to generate a trigger signal for a Triac looks odd, but it works very well. The diodes provide the Triac gate with a voltage-limited gate signal.

that forward-voltage drop is around 0.8 volts. So when the three diodes on the left are forward biased, each drops 0.8 volts, giving a total of 2.4 volts across the entire string of three (3 × 0.8). When the string of diodes on the right is forward biased, it also drops a total of 2.4 volts, but with the opposite polarity.

That voltage looks very much like an AC square-wave if viewed on an oscilloscope. That square-wave is sent to the gate of the Triac and used as a trigger signal. To summarize, if current flows through the device connected to SO1 the diode network supplies the Triac with a voltage-limited gate signal of the proper polarity. The Triac then turns on and supplies power to SO2.

There are brief intervals when the voltage across the diodes is above −2.4 volts, but below +2.4 volts. During those times both sets of diodes *do not* conduct. That would cause the Triac to shut off briefly once the current through the main terminals fell below the holding-current value. Resistor R1 allows some current to flow during those intervals so the Triac can deliver almost continuous current to SO2. Note that R1 can be a low-wattage unit because it never sees more than ±2.4 volts.

The nice thing about the circuit is that it will supply the same gate signal to the Triac regardless of the load connected to SO1. There is another advantage that is not readily apparent: the timing of the gate signal is so precise that the Triac generates almost no electrical noise when it turns on (an annoying characteristic of most Triac-based circuits).

I use a circuit based on this strange concept to power my computer set-up. My computer is plugged into SO1 and its peripherals are plugged into sockets controled by a Triac just like SO2 is. I leave all the peripheral's power switches in the "on" position so when my computer draws current

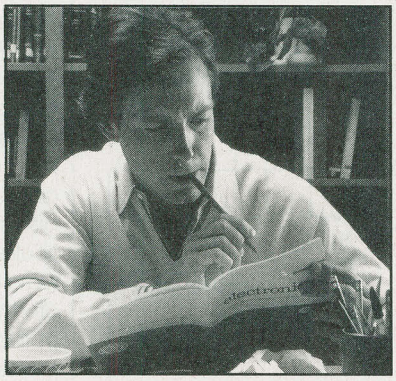
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(*i.e.*, is turned on) the peripherals "come to life" as well.

If you plan to play with Triacs, there are a few safety precautions that you should follow: First, any connections that carry heavy current should be made with 12-gauge wire. Also, keep in mind that substantial current through a wire junction tends to raise its temperature. Since solder will melt at relatively low temperatures, any connections between leads carrying respectable current should be made with a wire nut, not solder. Last, it's always a good idea to add a heat sink to all Triacs that you use.

Now let's look at a few power-control circuits submitted by some of you readers. As usual, their efforts will be rewarded with a Think Tank II book, or something similar from our selection.

WHAT IS IT?

I have a circuit (see Fig. 5) that I found recently at a yard sale. I bought it for only $1, but I've spent $100 in pure agony trying to figure it out. It seems to reduce the power to lamps and also works well as a wattage control for my soldering iron. Before I got it, my soldering iron would get hot enough to lift the traces right off a circuit board.

I really like the circuit because it adjusts my soldering iron from very low heat for IC's, to very high heat for chassis-grounding connections. Maybe this circuit would be of great use to other technicians, if only I knew what type of transistor TR1 was. Please help if possible.

—James Lancaster, Waco, TX

No problem (especially since you provided the ECG number)! The part you've labeled TR1 is a Triac. It receives a gate signal from a delay circuit composed of C1, R1, R2, and R3 at the junction of C1, R1, and R2. MT1 is connected to the AC line and MT2 is connected to the load. The delay circuit turns on the Triac during each alternation of the AC waveform. The longer the delay circuit takes to trigger the Triac (which is determined by the setting of R1), the later the Triac turns on in each alternation. The later the Triac turns on, the less average power is delivered to the load.

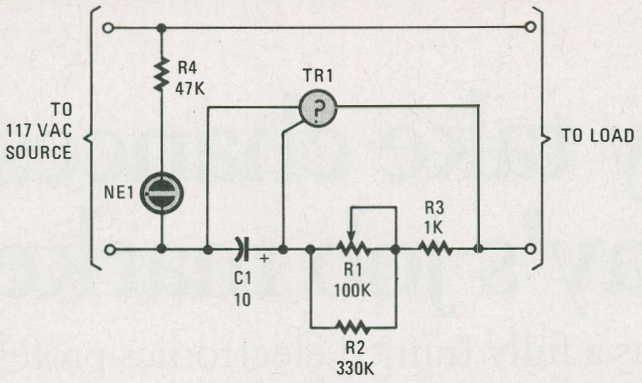


Fig. 5. This circuit is very useful for controlling power to lamps and soldering irons, but what is TR1?

KEEPING IT COOL

I installed a compact ice maker in an enclosure beneath my wet bar. When making a large amount of ice cubes, the cabinet became unduly warm. My solution was to have the ice maker turn on an exhaust fan when it operates. My first idea was to connect the fan supply leads directly across the ice-maker's compressor motor. Upon inspection, that proved to be more of an undertaking than it originally seemed. My ultimate solution was to have a Triac turn on the fan when triggered by the current drawn by the ice-maker's compressor motor (see Fig. 6).

In the circuit, the value of R1 (2 ohms) was chosen so that the current to the compressor (about 2 amps) develops 4 volts across it. I used two 1-ohm 25-watt aluminum-cased resistors in series to produce that resistance. Their high wattage allows them to withstand the current surge of the compressor.

Resistor R2 is used to limit the current surge to the gate of the Triac, and was also selected for my particular application. The Triac was selected to easily handle the power requirements of the fan.

I installed R1 in the bottom of a 2-inch deep metal duplex outlet box that acts as a heat sink for R1 and the Triac (which is insulated from the box with a mica wafer). The sockets are on a standard duplex unit with the jumper tab on the hot terminals removed so that the sockets operate independently.

—James W. Dowell, Chula Vista, CA

Very nice. Everybody should keep in mind that this circuit was designed only for your particular compressor and fan. To use it on other equipment will take some experimentation on the part of the builder.

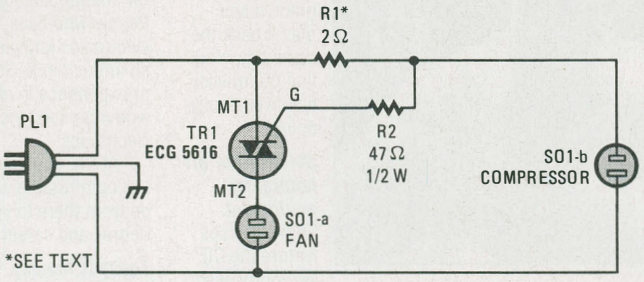


Fig. 6. When this Triac circuit senses current flow through SO1-a, it activates the device plugged into SO1-b. The values of the resistors must be chosen for the specific devices to be plugged in.

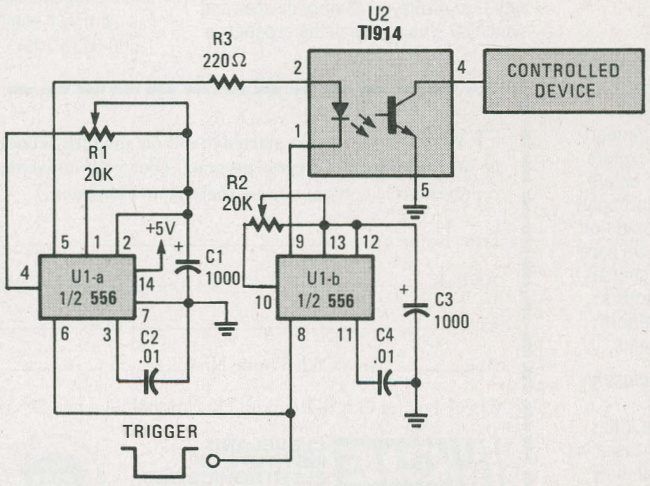


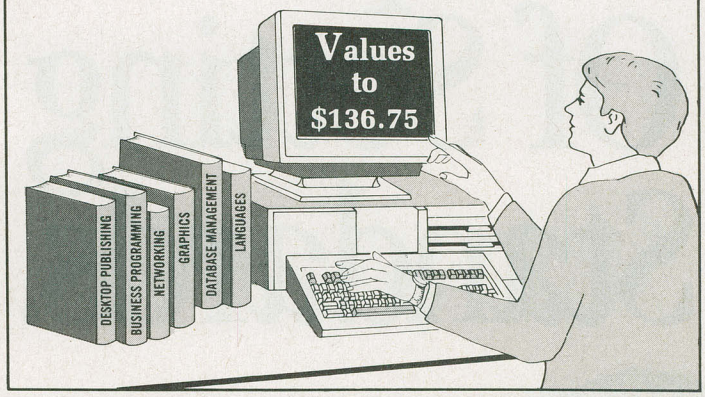
Fig. 7. This handy timer circuit has a turn-on delay and a turn-off delay. You can modify the circuit by replacing the optoisolator with a Triac-driver type and a Triac to control AC devices.

A SUPER TIMER

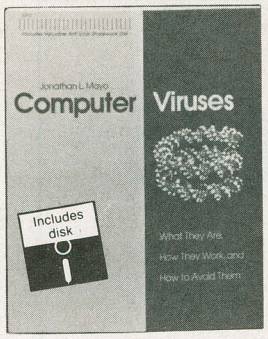
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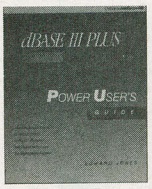
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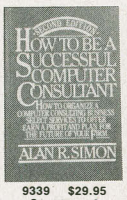
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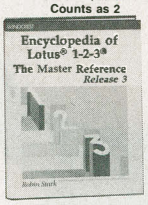
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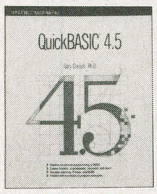
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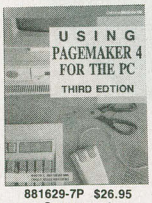
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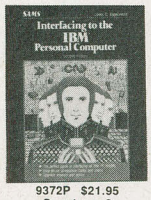
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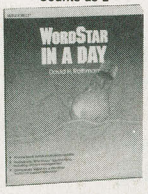
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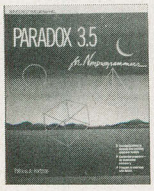
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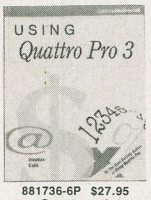
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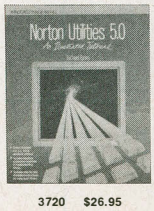
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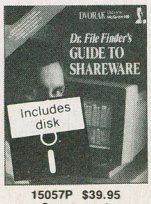
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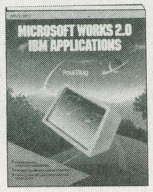


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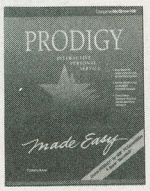


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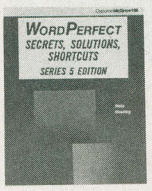
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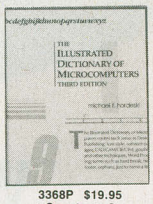
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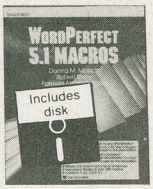
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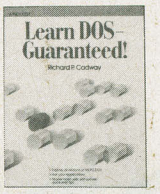
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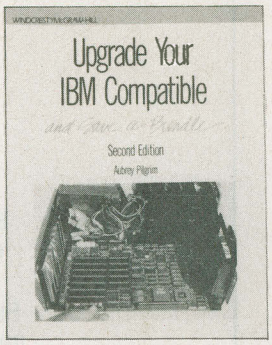
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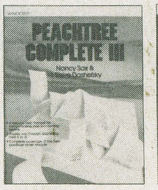
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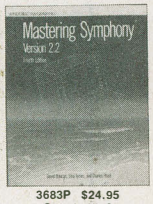
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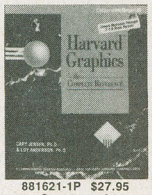
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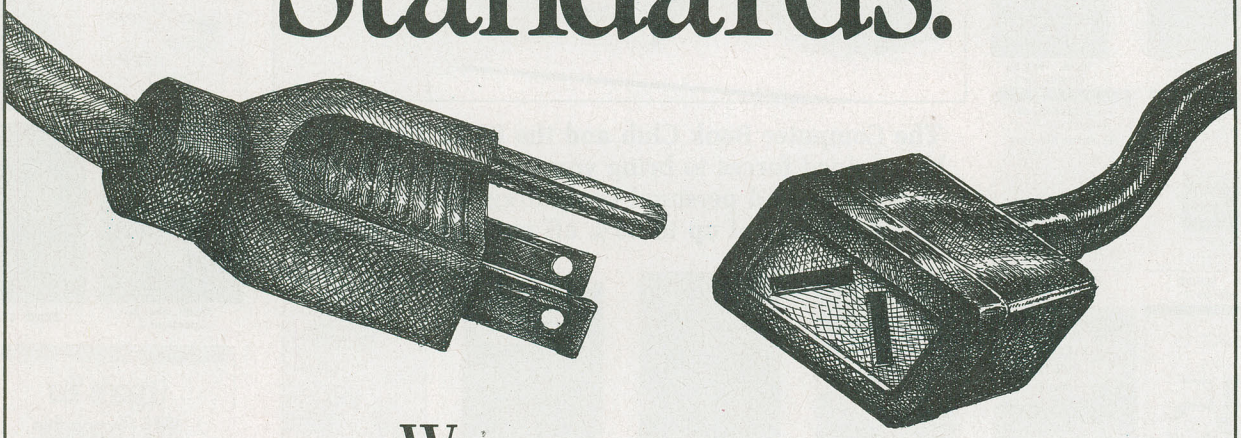
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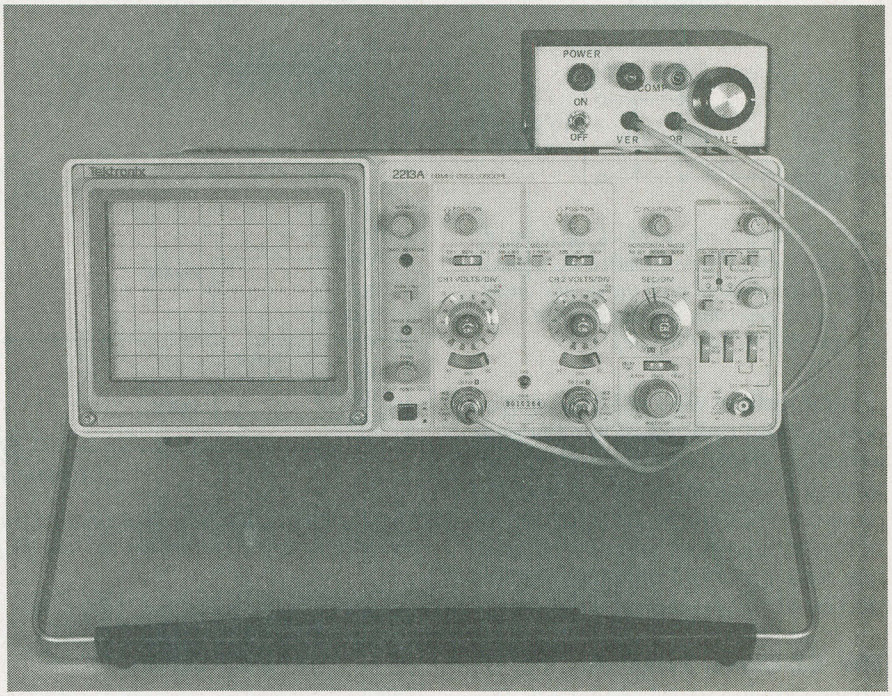
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BUILD A SIGNATURE TRACER

BY JOHN YACONO



Build an inexpensive precision component checker that will put your oscilloscope on an even footing with the newer models, replace some of your test gear, and teach you to interpret characteristic curves in the process.

It has often been said that a picture is worth a thousand words. That adage is just as true in electronics as it is in any other endeavor. In fact, the importance of "seeing" how a device operates prompted the development of oscilloscopes fairly early in this "age of electronics." To further the usefulness of oscilloscopes, some models today incorporate a "component-checking" feature. That innovation allows the scope to plot the "characteristic curve" of a component.

Essentially, a characteristic curve—a plot of voltage across a device versus the current through it—is the *signature* of the component. It reveals the most intimate details of a part's operation *while it's working*. In fact, if you can generate a curve and know what to look for, you can determine all the information that you'd normally find in a databook. What's more important is that your measurements will really mean something—they'll be applicable to the device you have on hand and not just a databook pipe dream.

By comparing the measurements that you make to the component's specifications or to the curve of a definitely healthy unit that you have on hand, you can determine exactly how the part is (or isn't) working and whether it's functioning suitably. Such information is useful for both troubleshooting circuits and selecting components of reasonable quality. That is great for checking out semiconductors that test fine on your multimeter, but fail in a circuit.

Such a feature also allows you to determine the important characteristics of reactive components (impedance, resistance, reactance, component value, and Q-factor). So basically, a scope can take the place of a capacitance meter and an inductance bridge in low-budget electronic workshops.

A plain oscilloscope allows you to observe a component's operation in a circuit, but most of them (especially in the hobbyist price range) can't provide you with a characteristic curve. If you don't know precisely how a component should be acting in a circuit point-by-point, a no-frills oscilloscope will be of no help.

Test-equipment manufactures are providing more and more oscilloscopes with a component-checker feature that allows them to plot the characteristic curve. But that doesn't help those of us who are not prepared to invest in a new scope. That's where the *EZ-Curve* oscilloscope accessory described in this article comes in; it can provide any oscilloscope with the ability to generate characteristic curves. Even an old scope can be used with the accessory, as long as it has at least a 60-Hz bandwidth and X-Y mode (those are pretty meager requirements).

Among the device's features are built-in current limiting (to automatically protect sensitive components), an adjustable current scale, and a design that can easily be altered to accommodate any special requirements that you might have.

Even though it's a precise test-instrument add-on, the EZ-Curve is a trouble-free project to build. The parts required for the accessory are common and can probably be found in your junkbox or, at the very least, at your local electronics-parts store. It can be built and adjusted in one evening, so you can put it to use almost immediately.

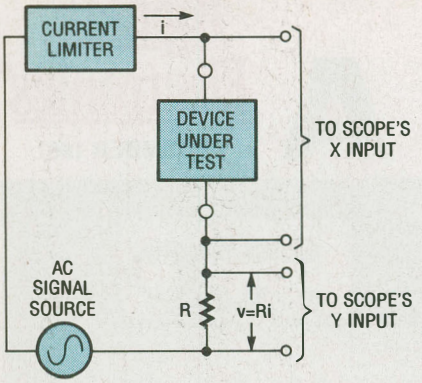


Fig. 1. This is a simple block diagram of the EZ-Curve. Current-limited AC signals are passed through both the device under test and a precision resistor to yield current and voltage readings.

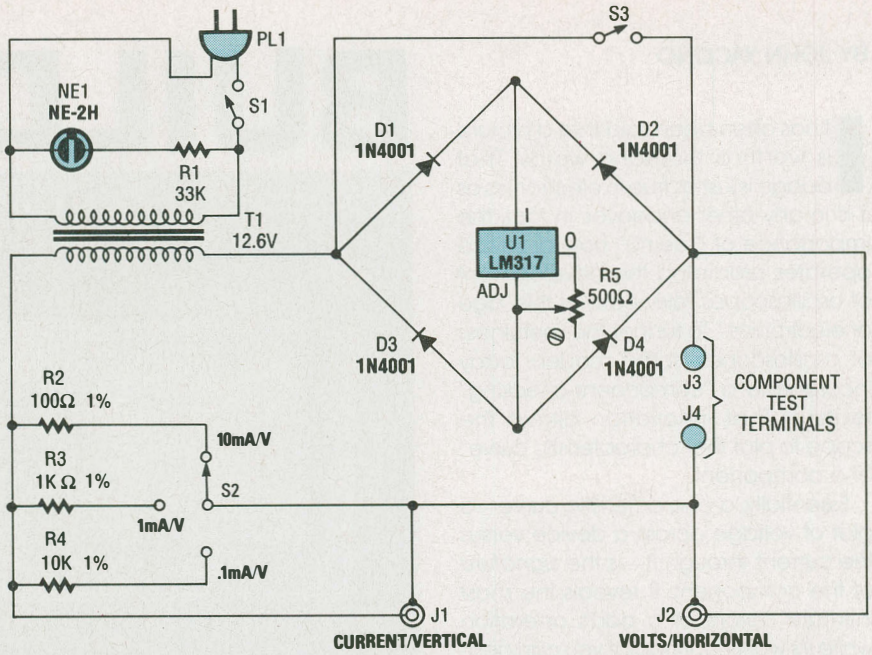


Fig. 2. In the actual EZ-Curve circuit a transformer is the signal generator, a voltage regulator acts as a current limiter, and the precision resistor is switch selectable.

In this article, we'll not only tell you how to build and adjust the EZ-curve, we'll also tell you what general characteristics to look for when testing the more common semiconductor and reactive components, and how to measure their important attributes. But let's start by discussing the circuit.

The EZ-Curve Principle. The EZ-Curve circuit is a bit unusual in appearance, so it's a good idea to first present a block diagram of it. As shown in Fig. 1, the circuit is basically an AC signal source connected in series to an active current-limiting circuit, the device under test, and a precision resistor.

As was mentioned, the current limiter is present to keep the current through the component being tested down to a safe level. An active current limiter was used instead of a simple resistor because a resistor would've limited the maximum voltage available to the device under test. That would be undesirable for testing certain components that require more voltage (such as Zener diodes).

Since everything is connected in series, the current flowing through the resistor is equal to the current through the component under test. According to Ohm's Law, the voltage across the resistor is proportional to the current through it. By connecting an oscilloscope across the resistor, you can watch the voltage and thus the current rise and fall as it flows through the component under test and the resistor. Note that we used a lower case "i" and "v" in Fig. 1 to indicate that those quantities vary with time.

You can make it easy to read the current right off the oscilloscope if you select the value of R wisely. For example, if R is 1 ohm, by Ohm's Law:

$$v = i \times 1 = i$$

so a 1-volt reading on the scope would mean 1 ampere of current is flowing through the component, a 2-volt reading indicates 2 amps, etc. The voltage across the component under test can be viewed by simply attaching an oscilloscope input across the component.

PARTS LIST FOR THE EZ-CURVE

SEMICONDUCTORS
U1—LM317 adjustable voltage regulator.
D1–D4—1N4001 rectifying diode

RESISTORS
(All fixed resistors are ¼-watt, 1% units unless otherwise noted.)
R1—33,000-ohm, 5%
R2—100-ohm
R3—1000-ohm
R4—10,000-ohm
R5—500-ohm, multi-turn potentiometer

ADDITIONAL PARTS AND MATERIALS
J1, J2—Male BNC connector
J3, J4—Banana jack
NE1—NE-2H neon indicator
S1, S3—SPST switch
S2—SP3T rotary switch
PL1—AC plug and line cord
T1—12.6-volt, 300-mA, power transformer
Perfboard material, coaxial cable, project case, wire, solder, etc.

Now let's say that you put your scope in X vs. Y mode, and you supply the X input with the voltage across the component, and the Y input with the voltage across the resistor. The signal source will supply the component with a current-limited AC sinewave, causing the scope to display the characteristic (V vs. I) curve. Why, you ask? Because the voltage across the device is presented to the X (horizontal) input, and a voltage proportional to the current controls the Y (vertical) input.

There is one catch, however: Scope inputs have a common shield—the shield of one input is electrically connected to the other via the chassis. So the shield on both inputs must be connected at the junction between the device under test and the resistor. The catch is that the polarity of the resistor will be opposite that of the component, causing the X axis to flip around; its positive side will be on the left and its negative side on the right. That is an aspect of commercial units as well as ours and can only be overcome at the expense of accuracy (and money).

Quite honestly, it wouldn't even matter if the characteristic curves came out upside down. What is important is that the user must know what to look for when viewing a curve, and we'll get into that a little later.

A Look at the Circuit. A schematic diagram of the EZ-Curve circuit is shown in Fig. 2. In that circuit, transformer T1

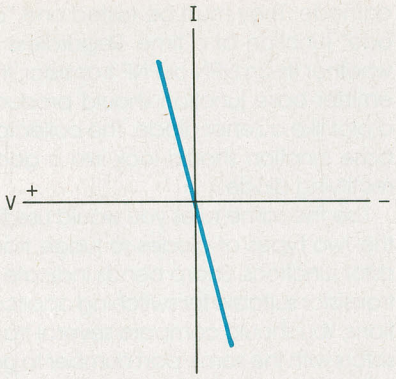


Fig. 3. Resistors produce the most boring characteristic curves. The inverse of the slope is the resistance.

acts as a very simple AC signal source. It receives its power from PL1 via the power switch S1. A neon lamp, NE1, is included in the circuit to indicate that the unit is on.

Resistors R2–R4 are precision units that take the place of R in Fig. 1. Switch S2 allows you to choose one of those resistors to get the scale you wish. For example, if you select R3, then a 1-volt reading on your scope indicates a 1-mA current flow. The voltage across that resistor is sent to the scope's Y input through BNC connector J1.

Integrated circuit U1 is the active current-limiting device. It is an LM317, which is normally used as an adjustable positive-voltage regulator, but it can be used as a current regulator when wired as shown. Multi-turn potentiometer R5 sets the maximum current level that the regulator will permit.

The LM317 is a DC device, even when used for current regulation, so diodes D1–D4 are used to steer the AC flowing through the rest of the circuit into the regulator with the right polarity. Keep in mind that only the regulator receives DC, the rest of the circuit is AC. The active current limiter can be removed from the circuit (shorted) by closing S3. That is useful for testing reactive devices, which don't require current limiting and yield a more informative curve without it.

The component that you wish to examine should be connected to the component test terminals, J3 and J4. The voltage across the component is made available to the scope's X input via J2.

Construction. Building the EZ-Curve couldn't be easier. That's because so few components are involved. We used a piece of perforated construction board and point-to-point wiring to do the job. Follow Fig. 2 as a wiring guide.

First mount all of the small components on the board, but be sure to leave enough room to mount the transformer on the board as well—leave the transformer for last, because it's easier to work on the board without T1's added weight. We used a PC-mounting potentiometer for R5 because it must be adjusted only once in the initial calibration of the unit. Therefore, you don't have to have front-panel access to that control.

We included an on/off switch (S1) and neon power-on indicator (NE1) in our prototype. If you don't have them on hand, or don't wish to go for the added expense, then it is perfectly alright to leave them out. In that case, just remember to unplug the unit when not in use.

Switch S2 must have at least three positions. Although the one in our prototype has a lot more than three, we used it because we had it on hand. You can use whatever switch you have on hand, or purchase an appropriate one.

Although shielding is not required on the connections to J1 and J2, we used lengths of shielded cable because it's easier to attach the required BNC connectors to that kind of wire. The BNC's connect to your oscilloscope inputs.

Two binding posts (J3 and J4) are used to connect the component under test to the EZ-Curve. They should be mounted for easy access on the front panel of whatever cabinet you use so that inserting a component to be tested is as simple as possible.

The size of the cabinet is determined by the overall size of the board and the height of the transformer. Since shielding is not a concern, you can use whatever kind of cabinet you like—plastic, metal, etc. The cabinet we used is best suited for front-panel mounting of the controls. However, depending on the cabinet you use, they can be mounted wherever it's most convenient.

Adjustment and Operation. The current limiter needs to be adjusted before you use the unit. If not adjusted properly you could damage the precision resistors as well as any component you try to test. Stick to the easy adjustment procedure that follows and no harm will befall you.

Start by connecting an ohmmeter across R5. Adjust that potentiometer to 125 ohms and remove the ohmmeter. Plug the circuit in and turn it on. Switch the scale control (S2) to the 1-mA/V position and make sure S3 is open. Con-

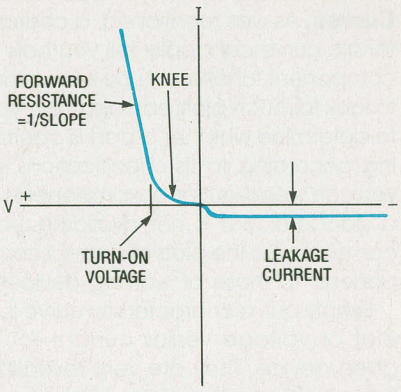


Fig. 4. A diode's curve reveals all of its important characteristics. The sharpness of the knee bend is important.

nect J1 to an input on your scope (the scope should not be in X vs. Y mode right now). The scope should display nothing at this time.

Connect (read that "short-out") the component test terminals (J3 and J4) together. You should see a slightly distorted sinewave of around 20 volts peak-to-peak. If not, carefully adjust the potentiometer, R5, being careful not to stray too much higher than 20 volts peak-to-peak.

Now switch to the 10-mA/V position and check the waveform. It should be less than or equal to 2 volts peak-to-peak. If it's higher, adjust R5 to lower the voltage. Remove the wire shorting J3 and J4 and you're all done with the adjustment procedure.

To use the unit, you should connect J1 to your scope's Y input and J2 to its X input. Before connecting a component to J3 and J4, ask yourself this unlikely question: Will the component be harmed by 10-mA? (This is usually only a concern with FET's and other semiconductors with high input impedance.) If the answer is "yes," set the scale switch to the 0.1-mA/V position and leave it there. That will limit the current to less than 2 mA, which is harmless for *any* device (and is a standard output-current limit for oscilloscope-based component checkers). However, for most semiconductors, you can use any scale that suits you.

If the component is an inductor or capacitor, close S3. That prevents the current limiter from altering the characteristic curve. As you'll soon see, that will allow you to gather the important information contained in the curve. However, this is not an important consideration when testing non-reactive components.

Non-Reactive Characteristic Curves. As was mentioned, a characteristic curve can really tell you how a component functions if you know what to look for. Such plots can also help you to determine whether a part is operating according to its specifications so you can weed-out poor components. If a standard plot is not available, you can compare the plots of suspect components to those of working devices.

Simply put, a characteristic curve is a plot of voltage versus current for a given device. They are very revealing because the relationship between current and voltage is all you need to know to use any component.

To give you more of a feel for what a characteristic curve is let's start by examining the simplest one possible: the "curve" of a resistor. As you might suspect, the characteristic curve of a resistor (its voltage to current relationship) is based on Ohm's Law:

$$V = IR$$

If you were to connect a resistor to an adjustable-voltage source, and plot the current through the resistor versus a number of different input voltages, the resulting "curve" would be a straight line. One over the slope of the line, which would be V/I, would be equal to the resistance. The steeper the slope the smaller the resistance.

Such a plot is not terribly useful (it's easier to use a multimeter), but it serves to illustrate how the EZ-curve works: If the resistor were connected to the EZ-curve, you would get a straight line. That's because the EZ-curve would apply a continuously varying (read that "sinewave") voltage to it and supply the scope with the resulting voltage and current information. If the resistor had a low value, the plot would look like the one shown in Fig. 3. (Remember the X-axis is flipped around.)

Other devices have more interesting and more informative curves. For example, a diode would generate a curve something like that shown in Fig. 4. The forward-bias portion of a good-diode curve should have a steep slope. Furthermore, the knee of the curve, where the diode begins to conduct, should be fairly sharp and close to the origin. Poor diodes will appear to have shallow slopes, wide bends, require too much forward voltage to conduct and/or breakdown too easily when reverse-biased. The last problem will manifest itself as a "tail" hanging off the end of the curve (see Fig. 5).

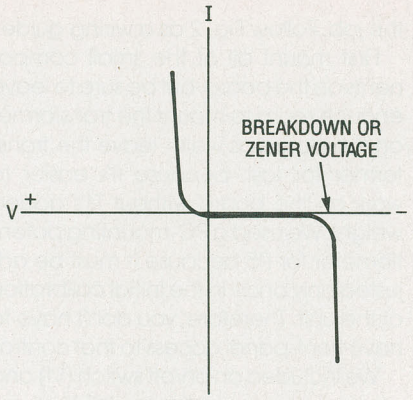


Fig. 5. Zener diodes look like diodes with a poor breakdown region when reverse biased. The breakdown voltage should be approximately the diode's specified Zener voltage.

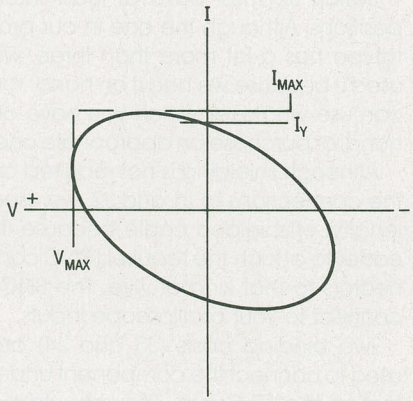


Fig. 6. This curve is typical of a reactance, whether a capacitor or inductor. The three important data points are marked here.

You can directly read the diode's reverse-leakage current and turn-on voltage from the oscilloscope trace. You can determine the forward-bias resistance of the diode by finding the slope of the forward-biased part of the curve and dividing it into 1.

Zener diodes will produce the same forward-bias curve as a normal diode, but the reverse-bias part of the trace will have a tail (like the diode in Fig. 5). Such a Zener is actually good. The tail should occur very near the specified Zener voltage, and the diode should be able to handle the rated Zener current at that voltage. Again, that can be determined directly from the plot. Unlike a regular diode, the forward-biased portion of a Zener can be ignored.

Bipolar transistors can be viewed as a pair of diodes tied together: NPN transistors are like two diodes placed anode-to-anode and PNP transistors are like diodes connected cathode-to-cathode. They must be tested one "diode" junction at a time. Regardless of whether its an NPN or PNP transistor, the emitter-base junction should produce a plot like a Zener diode. The collector-base junction should look like a good rectifying diode.

Use the same rules you would use for the two types of diodes to judge transistor junctions. Sharp bends indicate a transistor suitable for switching applications. You should compare several transistors with the same part number to get a feel of what to look for. The wide range of quality (and its absence) that you'll find among transistors purchased in bulk will probably surprise and perhaps disappoint you.

Reactive Components. As we mentioned, the device can help you determine impedance, Q-factor, and all the other attributes associated with reactive components (capacitors and inductors). You just have to take some readings off the scope and do a little simple math, as we'll explain.

Unlike the components we've already examined, the curves for reactive components look like slightly-tilted ellipses (see Fig. 6). Without getting too bogged down in theory, the ellipse-like shape is due to the fact that current and voltage in reactive devices do not change in step with one another. The slant just indicates that the component contains some DC resistance.

The important characteristics of reactive devices are impedance, Z; reactance, X; resistance, R; Q-factor, Q; and the value of the component: L for an inductor, C for a capacitor. You can determine all of these quantities by taking three measurements off the device's characteristic curve (look back at Fig. 6) and doing some very simple math. Keep in mind that since the EZ-Curve operates at 60 Hz, the values you obtain for impedance, reactance, and Q-factor are only true at 60 Hz. You will have to do a little extra math to determine those values for other operating frequencies. Of course, once the resistance and the value of L or C are determined, it is easy to determine Q, X, and Z for any desired frequency.

For our purposes, the sign of the quantities should be dropped, so as to make all your readings positive numbers. To further simplify things, the math is the same for both inductors and capacitors when determining Z, X, R, and Q. Only finding the components value,

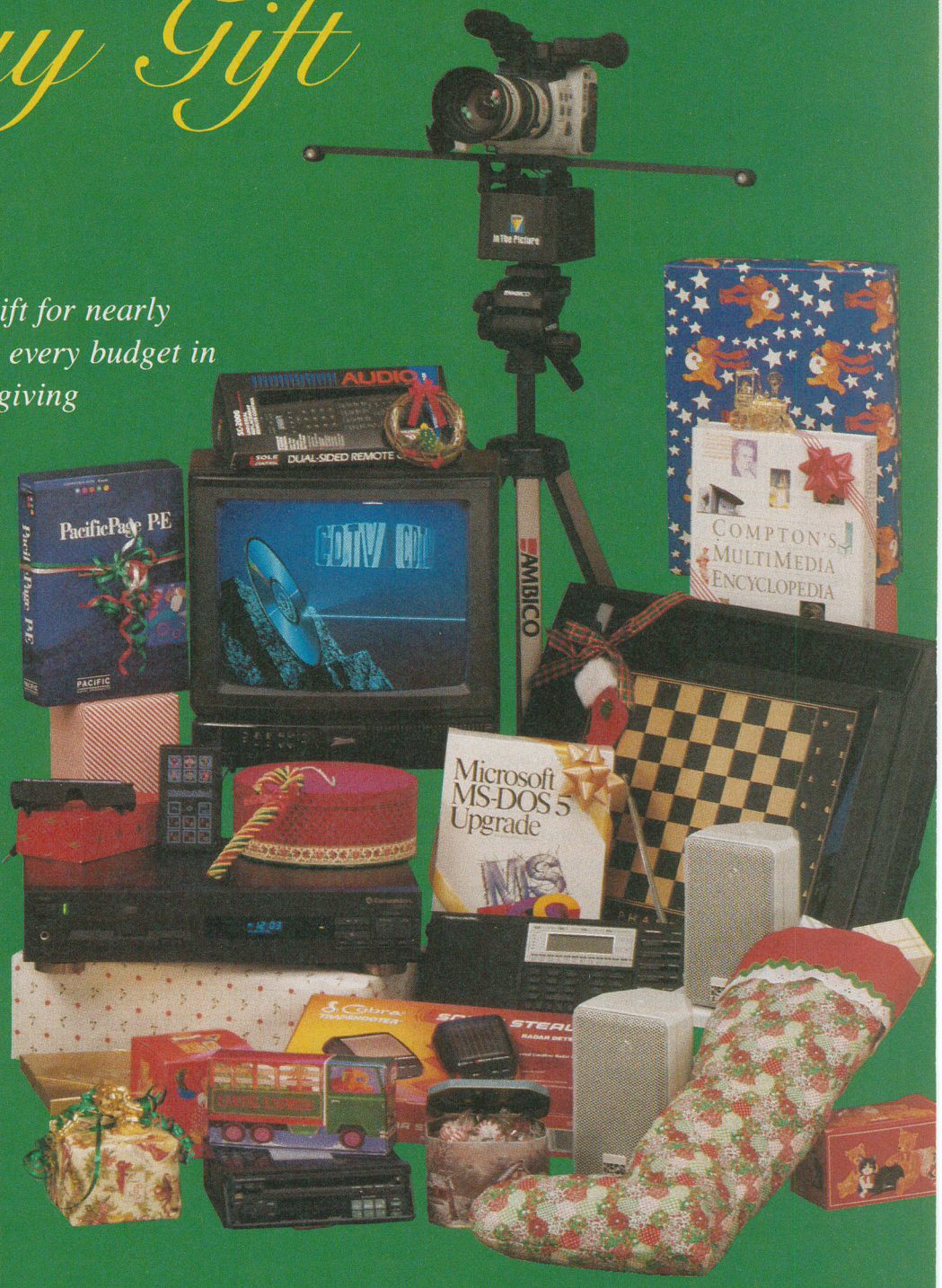
(Continued on page 88)

Popular Electronics®

By BRIAN C. FENTON and TERI SCADUTO

Holiday Gift Guide

Find the perfect electronic gift for nearly every interest and just about every budget in this handy guide to holiday giving



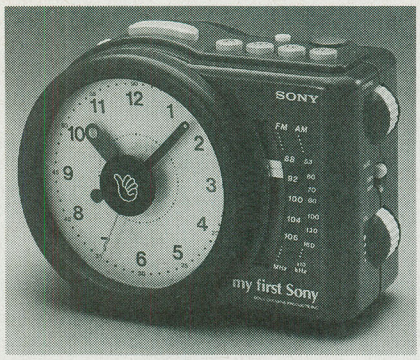
The holiday season is fast approaching. Ideally, that should conjure up images of family and friends, caroling, sleigh rides, parties, and tree-trimmings. In reality, those images are often obscured by the dread of shopping without a clue as to what to buy, and visions of frantic shopping expeditions in crowded department stores create unnecessary tension. (Who hasn't experienced 10-minute-to-closing-on-December-24th panic?) It's hard enough to find the perfect presents for friends and loved ones, let alone your boss or your mother-in-law!

Luckily, consumer electronics provides the solution to many gift-giving dilemmas. Here, we'll give you suggestions for people with electronics-related hobbies—videographers and computer buffs, for instance. But we'll also show how electronic gifts can be perfect for just about anyone on your list, from your toddler to your grandmother. And we'll try to show you gifts that will fit in every budget.

Gifts for Kids. Holiday gift-giving, of course, is really for the kids, and no age group is more receptive to electronics than children. Today's kids are exposed to electronic gadgetry from the day they're born—and sometimes even before! They certainly don't suffer that "fear of electronics" that plagues many of their grandparents (and some of their parents).

After all, what's to be afraid of, with such "friendly" gadgets as the *My First Sony Clock Radio* (Sony, $44.95). So kids won't miss a minute of their busy schedules, it wakes them on time with sound effects—a bird, a train, a dog—or, for kids who hanker for a taste of the rat race, an alarm. To help them learn to tell time the old-fashioned way, the clock sports a face with big hands and big numbers.

Another friendly electronics item for preschoolers is the *Rockin' Robot* (Playskool Electronics, $54.99). The AM/FM/cassette-recorder resembles a smiling robot, and has an easy-to-grasp handle, large brightly colored buttons, and a microphone so that kids can record their own songs as soon as they're old



My First Sony Clock Radio

enough to sing. It comes with an audio tape featuring children's recording star Joanie Bartels.

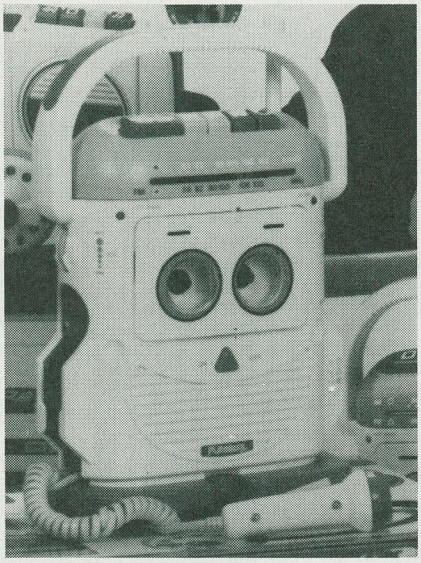
Now that rap music has become overwhelmingly popular, older kids may be fans of MC Hammer or Vanilla Ice. If that's the case, the *RAP-1 Rap Keyboard* (Casio, $99.95) lets them sound like real rappers. The instrument has a round "scratch table" that simulates the record scratching sounds used in rap music, a voice changer, 25 preset sounds and sound effects, and 30 different background-rhythm patterns.

Music has often been a source of strife between the generations. Have you had it up to here with rap? Are your youngsters playing videogames when they're supposed to be practicing their classical piano lessons? *The Miracle* piano-teaching system (The Software Toolworks, $379.94 for 8-bit NES or $479.95 for 16-bit NES and Amiga formats) lets them do both at the same time. It hooks up to a Nintendo system or Amiga computer and uses personalized video games and programs to teach kids (of all ages) to play the piano. It focuses on actual songs rather than repetitive exercises, provides a repertoire of songs ranging from the classics to rock, and uses self-paced progressive lessons for customized instruction.

If your children get tired of practicing, tell them "Don't have a cow!"—after they're done, they can play *The Simpsons: Bart vs. The Space Mutants* (Acclaim Entertainment, $44.95) or *Bart Simpson's Escape from Camp Deadly* ($27.95). Those games bring the ever-popular cartoon star to standard Nintendo Entertainment Systems and Game Boy handheld units, respectively. Cool, man!

If you're even more tired of listening to their videogames than their music, try putting the *LaserScope* voice-command optical targeting headset (Konami, $39.95) under the tree. It will allow your child to play any Nintendo Zapper Gun games by lining up the target through an "eyescope" and then saying "fire" when ready to shoot—giving a whole new dimension (and sound) to video-game playing. The LaserScope also doubles as headphones for stereo listening, sparing parents from loud music as well as video-game-generated noise.

Kids can also listen to music privately—and make a fashion statement—with the *Light Switch* stereo headphones (Koss, $9.99). Made of a light-sensitive plastic, the headband, yoke, and cord of the headphones change color in the sun. When biking, roller-blading, or at the beach, the headphones change from light pink to deep purple in a few seconds.

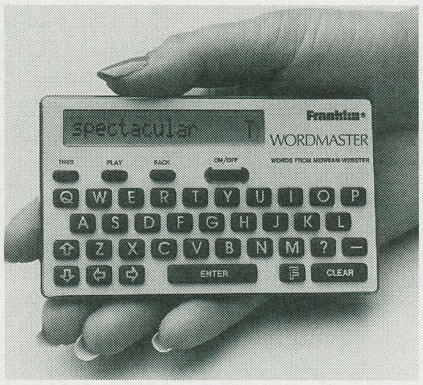

Playskool Rockin' Robot

Don't get the impression that children's electronics are all music- or video-game oriented. The board game isn't dead yet—just updated for the 90's. Youngsters nine years and older can travel around the world in the comfort of their living room with *Passport to the World* (Texas Instruments, $50), an electronic board game that teaches them about geography as they play. Players interact with the "electronic flight controller," which assigns destinations, poses questions, and updates players on their positions on the board. Players move by correctly answering questions about geography, famous people, food, sports, clothing, climate, and inventions. The first player to collect six passports wins—but such setbacks as lost luggage make travel difficult at times, just as in real life.

Finally, here's one you'll be tempted to "borrow" from the kids: The *TurboExpress* handheld video-game system (NEC, $299) has an optional tuner ($99) that allows it to double as a miniature color TV. The unit plays any 16-bit TurboGrafx-16 games with high-resolution and sharp colors.

Gifts for College Students. Older kids—high school and college students—might appreciate some gadgets to help make their classwork easier. Researching term papers has never been more convenient than with the portable electronic *Random House Encyclopedia* (Selectronics, under $350.). The pocket-sized reference tool lets students scan through its more than 20,000 entries using a key word or subject, and optional cartridges allow the addition of spelling and translator functions.

If your young students have trouble even starting research because they don't know how to spell the subject they're supposed to be researching, then wrap up the *Wordmaster* (Franklin, $59.95). By typing in a word the way it sounds, the compact thesaurus and spelling corrector displays the correct spelling, the definitions, and synonyms instantly.

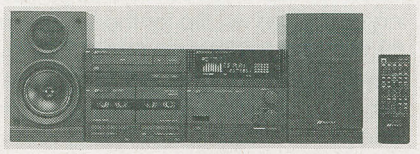


Franklin Wordmaster

After a hard day of classwork, most students have only the college cafeteria's "cuisine" to look forward to. So dorm residents are likely to appreciate the *MA-670M One-Touch* microwave (Goldstar, $219.95). Besides the standard microwave functions, this one features pre-programmed one-touch buttons for popcorn and pizza—dietary staples for college life.

The popcorn feature will come in especially handy if they also get to unwrap a *Sentry 2 model SJ1325* color TV (Zenith, $329.95). The 13-inch set is big enough to see, but small enough to fit in a crowded dorm room (and in the car

for the trip up to college.) With audio and video inputs, the Sentry 2 can act as a monitor. Of course, a remote control is featured, and a sleep timer should prevent tired students from leaving the set on all night.



Sansui "Robot Changer" Mini System

With all those electronic goodies, there will be little space left for an audio system, something no college student can live without. The *MC-2000* shelf system (Sansui, $849.95) has a footprint of only about 11 inches square, so it won't take up much space. Despite that small size, the system includes a 5-disc CD changer—perhaps the smallest on the market. Instead of using a cartridge or carousel, the changer uses a "robot" arm. Up to five discs can be placed in the first well. The arm picks up the top disc and moves it to the second well for play. When the disc is finished, the arm then moves the disc to a third well, and starts the process over again.

Gifts for Videographers. The camcorder has created a whole new group of hobbyists: amateur videographers. With almost three-and-a-half million camcorders expected to be sold by the end of this year, there's likely to be more than one videographer on your list, and there are plenty of gadgets on the market that are sure to be a hit with them.

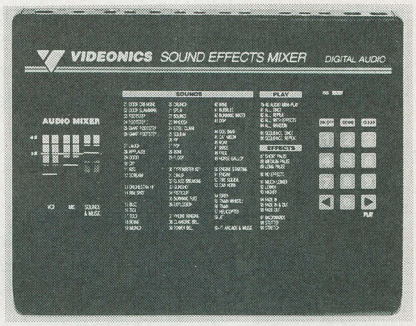
There's also a special camcorder that deserves mention. Sure to be at the top of any serious videographer's Christmas list is the *L1* camcorder (Canon, $2999). As the first to allow interchangeable lenses (just like a 35-mm camera), the L1 provides hitherto unheard of versatility. The Hi-8 camcorder accepts all VL-mount video lenses. With a special adapter, it can also use lenses from Canon's EOS "EF" 35-mm autofocus cameras. The full range of high-end camcorder features are provided, along with some special digital effects.



Canon L1 Camcorder.

The people manning a camcorder are often so busy capturing important family events on tape that they miss all of the festivities themselves. You can give family chroniclers a break with *In The Picture* (Visionary Products, $299), which tracks the main subject—the proud graduate, the birthday girl, or the guy dancing with a lampshade on his head—automatically. A remote transmitter clips to the subject's belt, and the receiver attaches between your camcorder and a tripod. As the subject moves around, In The Picture causes the camcorder to swivel on the tripod, tracking the movement while the videographer joins in the fun—and even gets in the picture!

Although a tripod is *required* to use In The Picture, it's *recommended* anytime you want to achieve smooth, jitter-free, professional-looking results with any camcorder. The model *V-0550* tripod (Ambico, $149.95) is sturdy enough to be used professionally, with even the largest and heaviest of camcorders. It incorporates numerous convenience features including quick-release camera mounts, fluid heads for panning and tilting, bubble levels, geared elevator crank, quick leg-locks, and sturdy locking leg braces. The anti-slip center column extends to a height of almost six feet!



Videonics Boing Box

Of course, capturing the action on tape is only half the job. Editing the footage into a cohesive, interesting, or even funny video is the harder part, although the payoff is worth the effort. There's no question that those clips shown on "America's Funniest Home Videos" wouldn't be so amusing without the added sound effects. The *Boing Box* sound-effects generator (Videonics, $179) lets the videographer on your gift list add not only music and narration,



Whistler Interstate Tripmate

but also 50 digitally sampled sound effects to their favorite videos. A digital sequencer makes it possible to program a series of sounds—footsteps, laughter, a squeaking door, and a "boing" sound, for example—as the action unfolds.

Gifts for Travelers. Whether for business or for pleasure, there's no question that Americans are on the move. If your gift list includes any frequent travelers, here are a few items that will make their journeys more pleasant.

Have you ever tried to unfold one of those huge roadmaps as you were driving, in an attempt to locate the next exit? Or decided to pass up a rest stop in favor of "the next one"—only to discover the next one is several hundred miles away? The *Interstate Tripmate* (Whistler, $99.95) is a pocket-sized electronic replacement for roadmaps and guidebooks that provides mileage and directions to key cities. It also provides up-to-date information about locations of gas stations, lodging, restaurants, tourist sites, and visitor information centers. An optional, plug-in memory module allows do-it-yourself information updates.

Know anyone who's planning a European tour, or whose business involves frequent international travel? They'd get a lot of use out of the *Interpreter II* (British Boston Marketing, $249.95), a talking, multi-lingual translator. The device translates words and phrases in English, French, Spanish, Italian, and German, and provides variable speed pronunciation so that you can more easily understand the spoken translations.

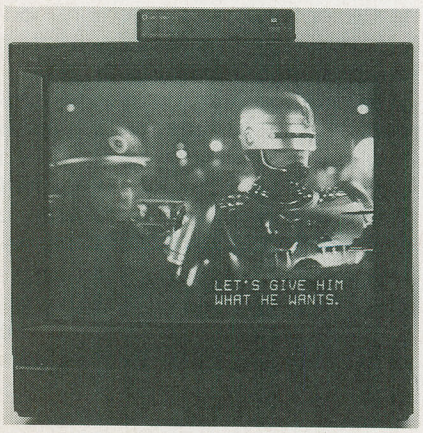
Anyone who travels on airplanes

knows how uncomfortable those headsets are, and how bad they sound. You can save someone on your gift list from those horrors with the *Air-Dapter* (Executive Travelware $34.95). The battery-powered amplifier plugs into the headphone jacks on an airplane's seat, amplifies it, and allows you to use a pair of standard headphones (included) for better, more comfortable sound. (You also save that $4 rental charge on each flight.)

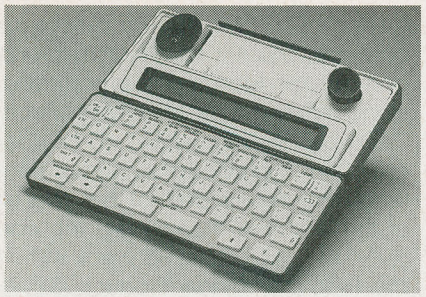
Gifts for Grandparents. It's difficult to categorize a group by any one characteristic (so please bear with the following generalizations), but senior citizens have different needs and lifestyles from other age groups. Retired people often have more time to spend on hobbies. Age often brings some physical problems like a loss in hearing or sight. And older people can be among the most resistant to new innovations in consumer electronics. Yet there are plenty of products out there that can enhance their lives.

Do you know someone with a lot of time on his hands—perhaps a retired person who could use both a hobby and some company? *Chesster* (Fidelity Electronics, $599) can provide both. Chesster is a walking, talking chess set that not only moves its own pieces, but gives a running commentary on the game in the form of helpful hints and smart-alecky quips. At its highest level of play, the game can beat 95% of the chess-playing population, so the play is always challenging. And Chesster has one big advantage over a garrulous real-life opponent—you can turn off its voice if it gets too annoying.

One of the unfortunate "side effects" of aging is often a loss in hearing. For those on your gift list who have hearing impairments, two devices would be welcome. The *TeleCaption VR-100*



NCI TeleCaption Closed-Caption Decoder



AT&T Telecommunications Device for the Deaf

closed-caption decoder (National Captioning Institute, $130) displays the hidden captions that are available on many live and recorded video programs. The compact decoder works with a VCR, cable converter, or satellite receiver. The *TDD 2700* telecommunications device for the deaf (AT&T, $249.99) allows hearing impaired individuals to type messages back and forth over the telephone line. A high-sensitivity switch helps eliminate errors in the incoming message that can be caused by a noisy phone line; a port for connecting an external printer also is provided.

If Grandma's VCR's display is *still* flashing 12:00 AM, that's a sure sign that the unit isn't being used to record any programs! One way to get around the cry of "I can't figure out how to program the



Gemstar VCR Plus+

darn thing!" is the *VCR Plus+* instant programmer (Gemstar, $59.95). With the VCR Plus+, anyone can master timer taping by simply typing in a special code (printed in *TV Guide* and several major newspapers) that corresponds to the show to be taped. It works with virtually any wireless-remote VCR and most cable-box/VCR combinations.

Copying VHS-C home videos of your kids onto standard VHS tapes so that your parents can watch them on their VCR is time-consuming—and unnecessary if you give your folks a PV-7000 VCR (Panasonic, $499). The unit accepts either standard or compact VHS tapes for recording and playback. No special adapter is required for playing VHS-C tapes.

Gifts for the Executive. Gadget-loving executives will flip for the *VoicePrint 50* two-line telephone (Ascom Communications, $209.99). Up to 20 numbers can be stored in memory and recalled by simply speaking the name of the person to be called! Up to 50 other numbers can be stored for push-button speed dialing. The VoicePrint 50 automatically selects the correct line for an incoming call and automatically selects the free line for outgoing calls.

The Rolodex, that indispensable tool found on countless desktops, has been updated. Give the "new and im-



Ascom VoicePrint 50

proved" (via electronics, of course) version, the EC-340 Desk-Top Rolodex (Radio Shack; $149.95) to the executive on your list. Information is typed in on a computer-style keyboard, and called up by scrolling or by typing in the first few letters of the name. There's room for additional information on each entry (besides the usual name, address, and phone number), and the unit provides other functions such as a monthly calendar, reminder notes, and lists of people to call or write. Best of all, if you also give an *EC-339 Pocket Rolodex* ($99.95), all of the phone numbers entered in the desktop model can be transfered to it in a matter of seconds (and vice versa), so that the phone directory that's carried is as up-to-date as the one that stays in the office.

If you know a frazzled executive who needs to find a way to relax, then the *MasterMind* "brainwave entrainment computer" (Synetic Systems, $229.95) might be a welcome gift. The MasterMind consists of a small, portable, battery-powered control unit, a pair of "LiteFrames" (solid eye glasses with high-intensity LED's built in), and a pair of headphones. The control unit will send pulses to the LED's and tones to the headphones according to built-in "sessions" or according to an external au-

MANUFACTURERS' ADDRESSES

Acclaim Entertainment Inc.
71 Audrey Avenue
Oyster Bay, NY 11771
CIRCLE 15 ON FREE INFORMATION CARD

Allsop, Inc.
P.O. Box 23
Bellingham, WA 98227
CIRCLE 16 ON FREE INFORMATION CARD

Alpine Electronics of America, Inc.
19145 Gramercy Place
Torrance, CA 90501
CIRCLE 17 ON FREE INFORMATION CARD

Ambico, Inc.
50 Maple Street
P.O. Box 427
Norwood, NJ 07648
CIRCLE 18 ON FREE INFORMATION CARD

Ascom Communications, Inc.
300-1(c) Route 17
Lodi, NJ 07644
CIRCLE 19 ON FREE INFORMATION CARD

AT&T Consumer Products
5 Wood Hollow Road
3L11
Parsippany, NJ 07054
CIRCLE 20 ON FREE INFORMATION CARD

Banner Band
535 North Wolf Road
Wheeling, IL 60090
CIRCLE 21 ON FREE INFORMATION CARD

BASF
Crosby Drive
Bedford, MA 01730
CIRCLE 22 ON FREE INFORMATION CARD

Bose Corporation
The Mountain
Framingham, MA 01701-9168
CIRCLE 23 ON FREE INFORMATION CARD

Britannica Software
345 Fourth Street
San Francisco, CA 94107
CIRCLE 24 ON FREE INFORMATION CARD

Canon U.S.A., Inc.
One Canon Plaza
Lake Success, NY 11042
CIRCLE 72 ON FREE INFORMATION CARD

Casio, Inc.
570 Mt. Pleasant Avenue
P.O. Box 7000
Dover, NJ 07801
CIRCLE 73 ON FREE INFORMATION CARD

Cobra Electronics Group
Dynascan Corp.
6500 West Cortland St.
Chicago, IL 60635
CIRCLE 74 ON FREE INFORMATION CARD

Commodore International
1200 Wilson Drive
West Chester, PA 19380
CIRCLE 75 ON FREE INFORMATION CARD

EuroSon America
694 Ft. Salonga Road
Northport, NY 11768
CIRCLE 76 ON FREE INFORMATION CARD

Executive Travelware
P.O. Box 59387
Chicago, IL 60659
CIRCLE 77 ON FREE INFORMATION CARD

Franklin Electronic Publishers
122 Burrs Road
Mt. Holly, NJ 08060
CIRCLE 78 ON FREE INFORMATION CARD

Gates Energy Products, Inc.
P.O. Box 147116
Gainesville, FL 32614-7116
CIRCLE 79 ON FREE INFORMATION CARD

Gemstar Development Corporation
135 North Los Robles Avenue
Suite 870
Pasadena, CA 91101
CIRCLE 80 ON FREE INFORMATION CARD

Goldstar Electronics International
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
CIRCLE 81 ON FREE INFORMATION CARD

Infrared Research Labs, Inc.
820 Davis Street
Suite 444
Evanston, IL 60201
CIRCLE 82 ON FREE INFORMATION CARD

Koss Corporation
4129 North Port Washington Ave.
Milwaukee, WI 53212
CIRCLE 83 ON FREE INFORMATION CARD

Magnavox
Division of Philips Consumer Electronics
One Philips Drive
P.O. Box 14810
Knoxville, TN 37914
CIRCLE 84 ON FREE INFORMATION CARD

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052
CIRCLE 85 ON FREE INFORMATION CARD

National Captioning Institute
5203 Leesburg Pike
15th Floor
Falls Church, VA 22041
CIRCLE 86 ON FREE INFORMATION CARD

NEC Technologies, Inc.
1255 Michael Drive
Wood Dale, IL 60191
CIRCLE 87 ON FREE INFORMATION CARD

Pacific Data Products
9125 Rehco Road
San Diego, CA 92121
CIRCLE 88 ON FREE INFORMATION CARD

Panasonic Industrial Company
Two Panasonic Way
Secaucus, NJ 07094
CIRCLE 102 ON FREE INFORMATION CARD

Panasonic Company
One Panasonic Way
Secaucus, NJ 07094
CIRCLE 121 ON FREE INFORMATION CARD

Playskool Electronics
Harborside Financial Center
400 Plaza Two
Jersey City, NJ 07311-3962
CIRCLE 122 ON FREE INFORMATION CARD

Pioneer Electronics (USA) Inc.
2265 East 220th Street
P.O. Box 1720
Long Beach, CA 90801-1720
CIRCLE 123 ON FREE INFORMATION CARD

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Division of Tandy Corporation
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RTW International Corp.
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3822 Stone Way North
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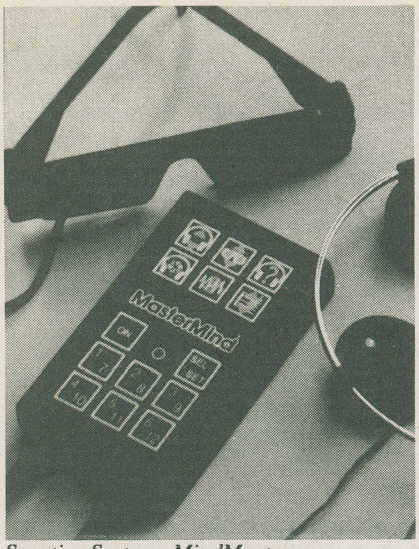
Texas Instruments
Consumer Relations
P.O. Box 54
Lubbock, TX 79408
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Videonics
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Campbell, CA 95008-6604
CIRCLE 132 ON FREE INFORMATION CARD

Whistler
Five Lyberty Way
Westford, MA 01886
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dio input. The idea behind the MasterMind is that pulsating light and sound can force your brain to produce brainwaves of certain frequencies. So, for example, if you want to enter an Alpha state (similar to what is achieved with transcendental meditation), you simply let the MasterMind get your brain to produce brainwaves between 8 and 12 Hz.

Gifts for Hobbyists. What do you get for a fellow electronics and computer hobbyist—or put on the top of your own list? You might start off with the *Realistic DX-440* shortwave radio (Radio Shack,



Synetics Systems MindMaster

$199.95). The receiver will not only keep you up to date on the latest world news, but bring it to you from different perspectives. Continuous tuning from below the AM band to 30 MHz is featured, with AM-, CW-, and SSB-reception modes. The FM-broadcast band can also be received on this high-quality portable.

If you want to make a computer user happy, then put the latest version of Microsoft's disk operating system *MS-DOS 5* (Microsoft, $99) under his tree. The latest release, called one of the most significant upgrades of MS-DOS in its ten-year history, promises to make the operating system much easier to use. A DOS "shell" provides an intuitive user interface that can be controlled by a mouse or another pointing device. Even an online help system is provided. A full-screen text editor replaces the EDLIN program that most users found difficult to use. And people who are constantly deleting the wrong files will appreciate that MS-DOS finally includes an "undelete" function. Power users will appreciate that the new version requires less memory, and effective memory-management can free up even more system memory. They'll also like the "task swapper," which lets you switch between applications quickly.

There's no question that "multimedia" is *the* buzzword for the 1990's. At the heart of multimedia, of course, is the CD-ROM drive, which allows your computer to access CD-ROM discs. Those discs can hold more than 600 megabytes of data, which can include text, graphics, and even audio. The *CDD46RS* external CD-ROM drive (Magnavox, $550) not only gives your computer access to CD-ROM discs, it also plays all CD audio discs. Unlike other drives with audio outputs, all the functions of the the CDD461RS can be controlled directly from the front panel, just like a standard CD player.

Even if you buy a CD-ROM drive for yourself, you can make your family happy that you did, with *Compton's Family Encyclopedia* (Britannica Software, $695). The CD-ROM disc contains all 26 volumes of the 1991 printed version of Compton's Encyclopedia—more than 8-million words in over 30,000 articles, 15,000 images, maps, and graphs, 30 minutes of audio, and an interactive multiple-window world atlas. Webster's Intermediate Dictionary is on line, as is a spell checker. A natural-language search and retrieval system lets users enter questions as they would speak them.

Laser printers were once expensive, esoteric devices. They've come down dramatically in price, thanks mainly to the efforts of Hewlett Packard, which now controls almost three quarters of the low-end laser market. Many users are finding, however, that their laser printers don't offer the flexibility, compatibility, and power that they need—power that is available only in PostScript-compatible printers. PostScript compatibility, however, can be added to HP LaserJet printers simply by plugging in the *PacificPage* PostScript emulation cartridge (Pacific Data Products, $499.) The cartridge is available for all HP printers, and offers 35 scalable fonts and powerful graphics capabilities.

Gifts for the Family. There are many consumer-electronics items with across-the-board appeal that can't be put in any one category. Some of them would make good "family" gifts; others might bring to mind specific people on your gift list.

There was a time in the not-too-distant past when families used to gather around the piano and sing songs together. You can give your family the gift of togetherness without buying a time machine (or a piano), with the *CLD-V820 Laser Karaoke* player (Pioneer Laser Entertainment, approximately


Pioneer Laser Karaoke


Commodore CDTV

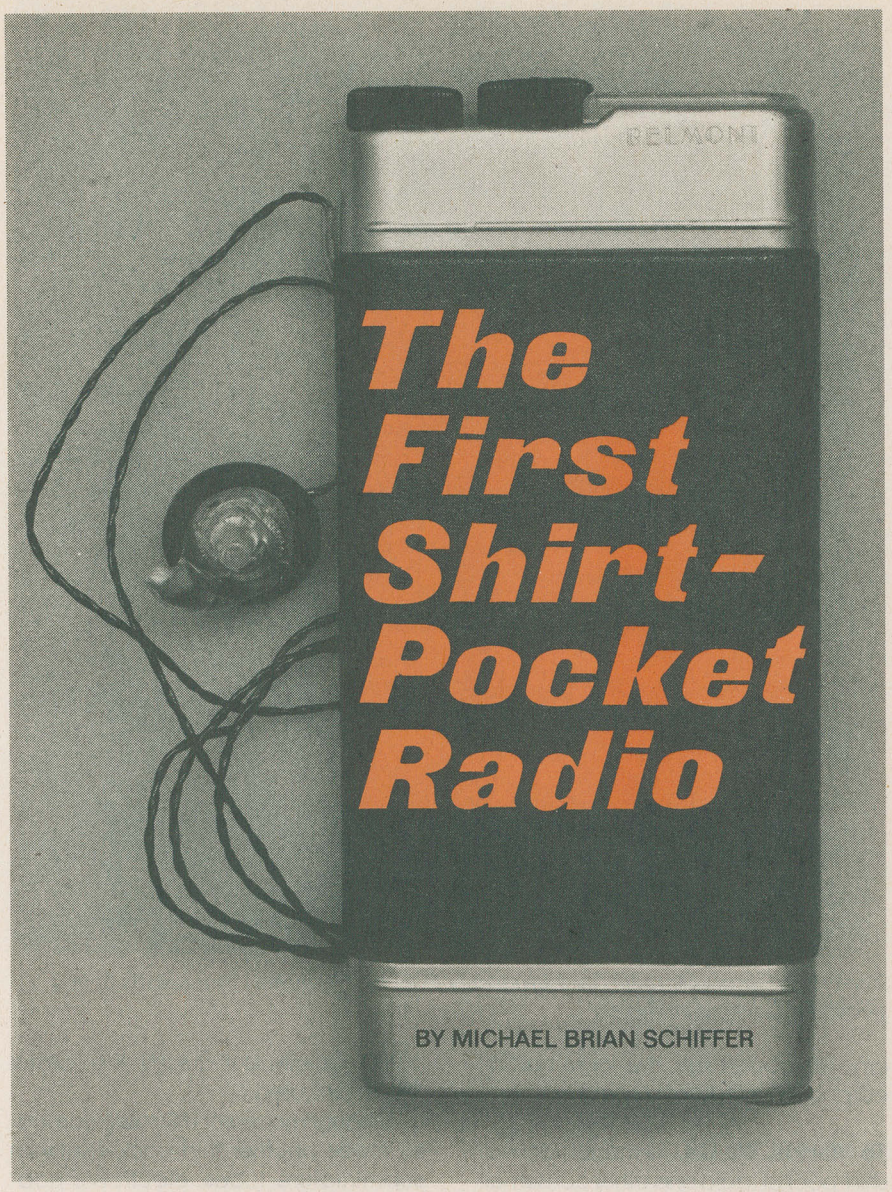
$1000). It allows the whole family to sing along with their favorite songs (with key adjustment to allow them to keep in tune) as the words and MTV-like video accompaniment appear on your television's screen. The unit also plays CD's and laserdiscs (with double-sided play for uninterrupted viewing). With a digital signal processor and surround sound, the CLD-V820 changes the dynamics of your home-entertainment system—creating a home theater environment—as it provides family fun.

Interactive media has hit the consumer-electronics market in the form of *CDTV* (Commodore, $999). The interactive multimedia player combines compact-disc and computer technologies, and hooks up to your television set and stereo system to provide audio, graphics, video, and text that you can access using a remote control. Available software ($39–$79) offers something for every member of the family, from cookbooks and gardening guides to MIDI music-making programs, from encyclopedias to sophisticated video games, from classic children's tales to Trivial Pursuit. Besides playing special CDTV discs, the machine also plays standard audio CD's and the newer CD+G (Compact Disc + Graphics) discs.

One thing that any electronics-minded family can do without is remote-control clutter. The *Sole Control SC-2000* remote control (Infrared Research Labs, $129.95) promises a solution by replacing all of your present remotes with a single unit. Guaranteed to operate any brand of audio/video equipment, the Sole Control is unique in its dual-sided design—one side controls audio devices, the other operates video devices. Up to 16 individual components can be controlled. Head-to-head programming is not required.

A remote control isn't always the solution, however. If you like to record and listen to your own cassettes, the remote works for only so long—you still have to get up to change tapes. But with the *CT-WM77R Six-Plus-One Cassette Changer* (Pioneer, $510), you won't have to get

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The First Shirt-Pocket Radio

BY MICHAEL BRIAN SCHIFFER

The idea of a radio receiver small enough to fit in a pocket goes back to the beginning of the century, before entertainment broadcasting. The great Nikola Tesla himself envisioned "A cheap and simple device, which might be carried in one's pocket (that could) . . . record the world's news or special messages." He made that statement in 1904!

The pocket radio did not remain just an idea for long. The pages of Hugo Gernsback's radio and science magazines, especially *Modern Electrics*, *Electrical Experimenter*, and *Radio Amateur News*, contain descriptions and pictures of pocket wireless sets built as early as 1909 by amateurs and experimenters. The ingenious designs were not stellar performers, but they did advertise the cleverness of their youthful creators. Though compact, these sets, which contained crystal detectors and not much else, also needed external antennas and grounds. Ironically, operation of the pocket "wireless" required wires.

By the time transistor action was first demonstrated, the first commercial shirt-pocket radio had already come and gone!

Technology appropriate for making truly *portable* pocket radios was slow in coming. Throughout the twenties and thirties larger portables with vacuum tubes were sold by many manufacturers; most resembled small suitcases. With few exceptions, there was little impetus from consumers or manufacturers to develop miniaturized tubes and miniaturized batteries.

Among amateurs and electronics enthusiasts, however, the idea of a pocket radio lived on. Radio magazines publicized especially compact sets that enthusiasts built in cigar boxes and camera cases. Throughout that period, Gernsback's *Radio News* and *Radio-Craft* magazines continued to urge the miniaturization of portables.

In one famous episode from 1933, Hugo Gernsback himself, using the pseudonym Mohammed Ulysses Fips, reported a new set that seemed, finally, to achieve the ideal. The set was billed as "A Revolutionary Radio Development—The Vest-Pocket 7-Tube Superhetero-Ultradyne," that was attributed to the Westing*Mouse* company. The mini-tubes—about an inch long and 3/8-inch in diameter—were denoted "APR-1" after the month in which the article appeared. Taken-in by the April fools's spoof, some readers wrote to Westinghouse seeking to buy their pocket radio. Westinghouse officials were not amused. But Gernsback did get the last laugh: by the end of the decade, tubes as small as the fanciful APR-1 were being produced commercially.

Raytheon Takes the Field. "Subminiature" tubes were the handiwork of Norman Krim and his colleagues at Raytheon; which, in the late thirties, was only a small firm that mostly made radio tubes. After doing some sleuthing in 1938, Krim determined that hearing-aid manufacturers could become a large market for miniaturized tubes. Krim proposed a project to make hearing-aid tubes to Raytheon's President, Laurence Marshall. Marshall asked Krim if he would quit in the event that the tubes failed to pay back the development costs. Krim said yes, and the work began. After months of trial-and-error, the Raytheon team succeeded. Hearing aid companies responded with orders for subminiature tubes, and Krim kept his job.

Subminiature tubes were further miniaturized and "ruggedized" during World War II for use in a variety of secret weapons. Among the most important of these was the proximity fuse, a tiny radio transceiver that triggered bombs and artillery shells when the latter approached their targets.

Excerpted with permission from *The Portable Radio in American Life* by Michael Brian Schiffer, the University of Arizona Press,1991.

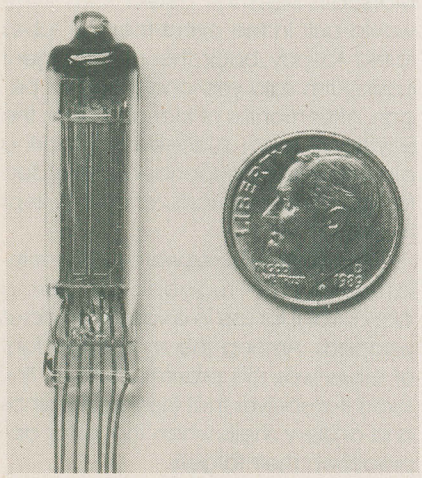
As the war drew to a close in early 1945, Raytheon executives (which now included Norman Krim) held a strategy session at Laurence Marshall's home to discuss various projects that could maintain the company's prosperity after the war. Many ambitious, high-tech projects were proposed, including microwave ovens (using Raytheon's magnetrons), televisions, and microwave-communications systems. When it was Krim's turn to propose a product, he picked something more prosaic: a shirt-pocket radio.

It is not difficult to surmise where this idea came from. Krim had been a radio amateur and, as a child during the twenties, had devoured Gernsback's radio magazines and built sundry apparatus. Perhaps he had even seen the WestingMouse portable with its subminiature-like tubes, or maybe he had responded to Gernsback's incessant editorials calling for ever-smaller portables. In any event, Laurence Marshall again gave Krim the go-ahead.

Krim assigned Niles Gowell the task of designing the world's first commercial shirt-pocket radio. It would not be a novelty or toy radio, but a superheterodyne unit. Working closely with Lemuel Temple, a battery expert, Gowell created a sophisticated 5-tube set only 5/8-inch thick and small enough to slide easily into a shirt-pocket. Hearing-aid parts were used in the audio section, but some new miniaturized components were crafted for the RF and IF stages. The radio also required production of a new family of subminiature tubes. The filaments were powered by two penlite cells, while a small 22.5-volt hearing-aid battery supplied the B+ voltage. Like many modern shirt-pocket sets, the radio had an earphone instead of a speaker.



The Privat-Ear pocket radio, measuring only 5 15/16 × 2 9/16-inches, could easily fit in a pocket for listening on the go.



As you can see even the more complex subminiature tubes used in pocket radios were very small indeed.

To Market We Go. To manufacture its shirt-pocket radio and other consumer-electronic products (among other reasons), Raytheon bought the Belmont Radio Company of Chicago in 1945. When presented with the prototype, the Belmont people were not impressed; after all, they knew radio and radio retailing. In their view, this high-tech item would have few buyers because it was a novelty item. Despite Belmont's reservations, the pocket radio entered production in late 1945.

A full-page ad in *Life* magazine, on December 3, 1945, announced the birth of the "Belmont Boulevard." A signed painting pictured the radio, actual size, nestled between a set of keys and gloves. It was a handsome radio, reminiscent of earlier "sport sets" made by hobbyists.

However, as Belmont had predicted, customers did not swarm around stores to await arrival of the first shirt-pocket portable. Total sales reached at most 5,000. Quietly, but quickly, the "proto-Walkman" died.

Although no major U.S. radio company made another shirt-pocket set with subminiature tubes, electronic hobbyists used this most appropriate technology for homebrew pocket radios. Such radios were publicized in *Popular Science, Popular Mechanics, Radio and Television News*, and other magazines. A few very tiny companies sprang up in the post-war years to exploit the possibilities of the Lilliputian radio. The sets they made were novelties and attracted little notice. The *Privat-Ear* was the most popular of this genre, enjoying sales from 1951 to about 1954.

Shirt-pocket radios, built with subminiature tubes, failed to find a mass market in the late forties and early fifties. These sets had obvious technical shortcomings, such as poor sensitivity and very short battery life, yet no company invested much effort in improving them. Radio firms judged that a pocket radio with an earphone was not apt to become a necessity for more than a

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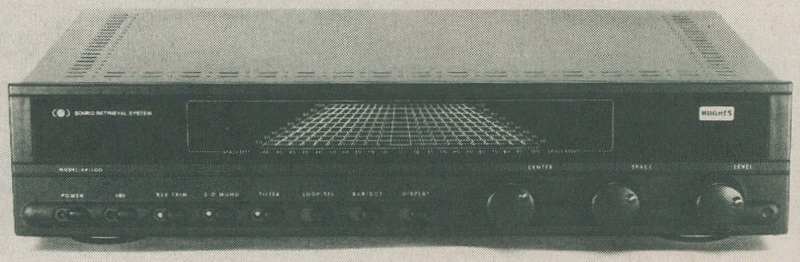
A CHRONICLE OF CONSUMER ELECTRONICS

DECEMBER 1991

VOLUME 4, NUMBER 12

Golden Sound Retriever

HUGHES AK-100 SRS AUDIO PROCESSOR. Manufactured by: Hughes Aircraft Company, Microelectronic Systems Division, 29947 Avenida de la Banderas, Rancho Santa Margarita, CA 92688. Price: $449.



CIRCLE 50 ON FREE INFORMATION CARD

We sometimes wonder whether the "home theater" craze is real, or if home theater is simply a catchy marketing phrase intended to boost the sales of audio/video components. *We* believe in it—but then, we get to try out the best of home-theater equipment. And we know that a plethora of consumer-electronics manufacturers are putting their faith in it. But what about Mr. and Mrs. Middle America?

Sure, they've heard about home theater. It's hard to miss all those large-screen projection and direct-view TV's out there, not to mention the stereo MTS audio that's become *de rigueur* for any new video equipment. But have Mr. and Mrs. Middle America experienced it in their own homes, or the homes of their friends?

To recreate that movie-theater experience, a surround channel—and the speakers that accompany it—are necessary. Unfortunately, they present some obstacles to the average consumer, only one of which is price. There's also the intimidating setup. Unless you're very confident about your "ear," how can you be sure that all those new components will sound the same at home as they do when professionally adjusted and arranged in the showroom? Finally, there's that extra pair of speakers that have to be installed.

Interior designers have never been fond of audio systems, with all those components and speakers that don't fit into any decorating scheme except ultra-modern. Home theater just makes things worse. Besides the oversized TV and the stereo speakers, now there are those rear speakers to worry about—assuming it's not a Dolby Pro Logic setup, which also requires a center channel for the most convincing reproduction, or a very long room, which requires side speakers as well.

We're sure that some interior designers and non-audiophile consumers have wondered why all those speakers, and precise adjustments and placement, were necessary. (They couldn't hear the difference anyway.) Well, some audio-conscious engineers are asking the same question. And the engineers at *Hughes Audio Products* have come up with an answer—the *AK-100* stand-alone *Sound Retrieval System (SRS)* audio component.

Although the AK-100 is new, the Sound Retrieval System, or SRS, isn't. First introduced in late 1989 in Sony XBR television receivers, and later on some high-end GE/RCA sets, SRS has finally been introduced as a stand-alone component.

The goal of SRS is to produce accurate, three-dimensional sound from two speakers. While effectively turning your audio system into a ventriloquist—that is, making sounds seem to come from outside the physical limits of stereo speakers—might sound like a lofty and impossible goal, it's based on sound principles. (No pun intended.) To understand those principles, we must first understand how our ears normally work to interpret sounds and where they come from, and why microphones don't work the same way.

Let's presume that you are watching a play from near the front of the orchestra section in a small theater. The sounds you hear are primarily direct waves, but your ears are also hit by a number of indirect waves—reflections of the actors' voices and the orchestra that come from the ceiling, side and rear walls, etc.

When you're in the theater, you may not hear any discrete reflections—even if you try to. However, they undoubtedly affect what you hear. If you were to close your eyes, there's no way you could imagine that you were sitting in your living room. Even if you place microphones in the same location where you are sitting and make a recording, that recording won't sound like the live experience when you play it back in your living room. The reason, simply enough, is that the microphones aren't your ears.

Your ears "hear" sounds differently depending on the direction from which they come. That's mainly due to the outer ear (*pinna*), and the section that leads to the ear canal (*choncha*). Together, they act as a direction-sensitive filter that emphasizes some frequencies, attenuates others, and even lets some frequencies pass through unchanged.

A manual that accompanies the AK-100 describes a very convincing experiment that you can try for yourself to demonstrate the importance of how our ears perceive sounds depending on the direction of the source: Simply rub your fingers together in front of, but close to, your head. Then bring your hand around to the side of your head. You should notice two things. First, the volume will get louder. Second, you should notice an increased emphasis on high and middle frequencies. The demonstration is a simple, but effective, way to show that we do, indeed, hear sounds differently depending on the direction from which they come.

Omnidirectional microphones, however, have a flat frequency for sounds com-

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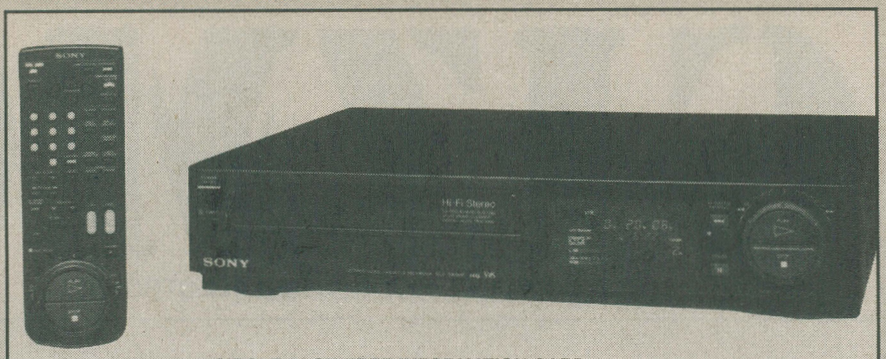
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CIRCLE 51 ON FREE INFORMATION CARD

VCR: The Next Generation

SLV-585HF HI-FI STEREO 4-HEAD VCR. Manufactured by: Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656. Price: $600.

Soon after their introduction in 1975, videocassette recorders quickly gained unprecedented market acceptance—and made a remarkable impact on America's viewing habits. Less than 20 years later, almost three-quarters of American households own a VCR, and many have more than one. Despite that high rate of market penetration, there is still a demand for VCR's. That demand stems primarily from two sources. There are those families who purchase a second—or even a third—unit, to go with a second (or third) TV for family viewing, or so that the kids can have their own VCR's. Then there are those people—and we know quite a few—who have been anxiously awaiting the final demise of the original VCR's that they bought a decade ago. In our experience, those video "dinosaurs," which deservedly earned the entire product category the unsavory reputation of being impossible to program, are rarely mourned. In fact, most owners of defunct first-generation VCR's view their passing as a cause for celebration—and the perfect excuse to go out and buy one of today's dramatically improved models.

Those who are buying a second VCR for their kids would probably opt for the bare-bones models (most of which, while lacking in bells and whistles, still represent a big improvement over older equipment). Sony is targeting their *SLV-585HF* at the other segment of the market—those who are looking to upgrade—whether they're replacing worn-out units, or have decided to give the old VCR to the kids and treat themselves to a sophisticated, but easy-to-use, new one.

The SLV-585HF is a four-head, high-quality VHS, hi-fi stereo unit with a host of convenience features. On-screen menus guide you though the setup: from entering the time and date, to automatically presetting all receivable channels (you can manually add or delete others), from changing the audio mode, to selecting the antenna mode. The unit automatically adjusts the tracking, has a built-in head cleaner, provides an indexing system, and has front-panel inputs for a camcorder.

The faces of both the main unit and the remote control (which Sony calls the "UniCommander") are dominated by a dual-mode jog-shuttle control, with an outer rim, which can be rotated clockwise or counterclockwise, surrounding two large, semicircular Play and Stop buttons. The shuttle is used to control most primary functions, including play, stop, fast forward, and rewind, as well as frame-by-frame advance, variable-speed slow motion, and high-speed search—all without having to hunt around for a bunch of tiny buttons. By turning the outer rim in various increments, you can move the tape forward or backward in ⅓-, normal, and 2-times speeds in play mode and at 7- and 21-times speeds in search modes. Besides the jog shuttle, the main unit is starkly clean, with only four buttons (Power, Eject, Pause, and High-Speed Rewind), a display window, and the tape compartment visible on the front panel. Controls hidden in a compartment under the tape well include Mode selector, Sharpness, and Clear (which resets everything); jacks for audio and video are also located there. Several other controls are located inside the door to that compartment, including those for channel selection, recording, tracking, quick timer, and editing. In contrast, the UniCommander (which can also be used to control other Sony video equipment) has about thirty buttons on its face, plus a 0–9 numbered keypad, but it is fairly well arranged (with one exception that we'll discuss later).

As we began experimenting with the dual jog-shuttle, one feature of the SLV-585HF made itself immediately apparent—the smooth, fast transition from one play mode to the next. Sony's proprietary "Rapid Access Tape Transport System" keeps the tape partially wrapped around the head drum at all times, so the deck goes from stop to play in a fraction of the time needed on most other decks we've

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Cordless Convenience

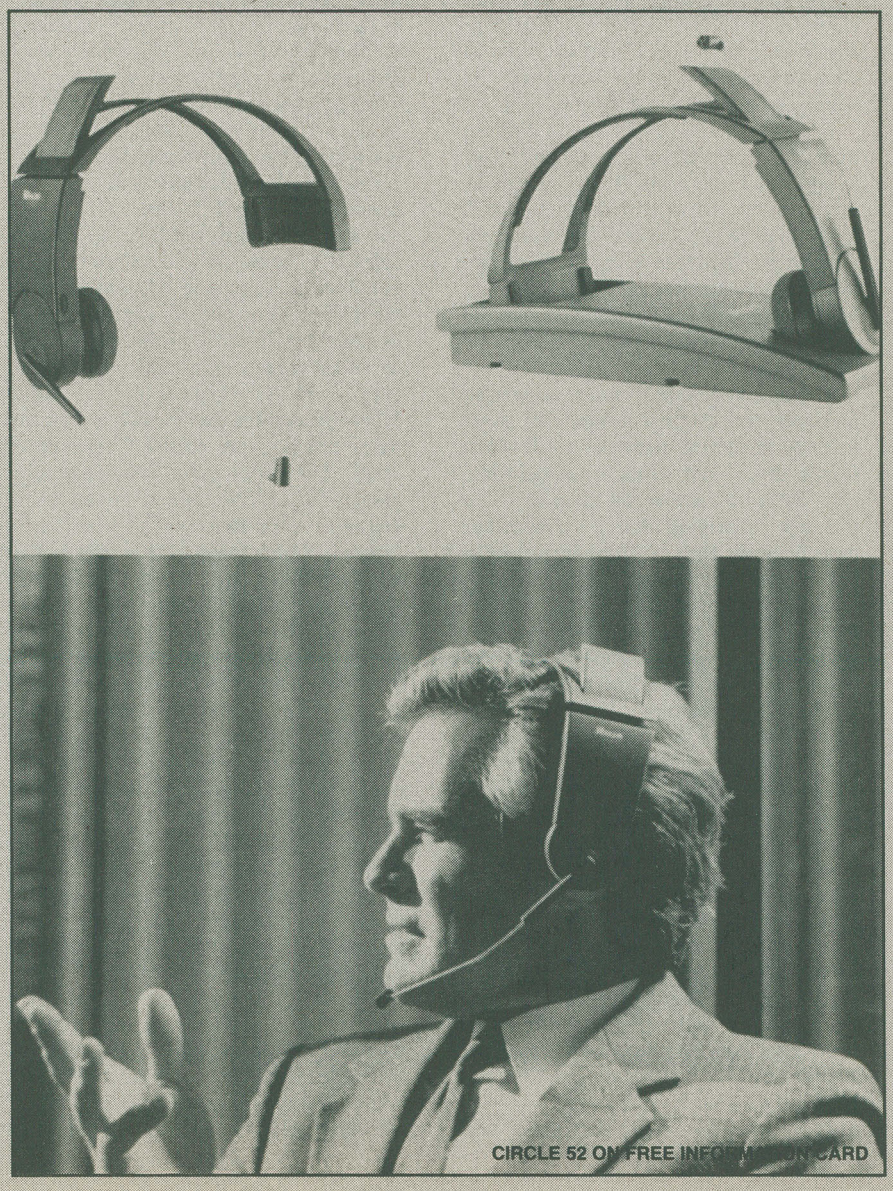
HELLOSET CORDLESS TELEPHONE HEADSET. Distributed by: Hello Direct, 140 Great Oaks Blvd., San Jose, CA 95119. Price: $399.00

If you have never pulled a telephone off your desk or knocked the coffee pot off the kitchen counter as you stretched the handset cord just a bit too far, then you're a rare individual, indeed. Our informal poll didn't turn up *anyone* who was immune to phone accidents.

We've now added a cordless phone to our arsenal, which lets us walk around our home without pulling the phone off our desk; and without the cord, we don't have to worry about knocking the coffee pot off the kitchen counter. Unfortunately, it's a partial solution at best. First, of course, we know how easy it is to eavesdrop on cordless-phone calls, so some calls require that we use a standard phone. Second, as hard as it is to cradle our normal handset between our ear and our shoulder with the cord gently tugging it away, our cordless phone, because of its shape, is even more uncomfortable.

Of course, the problem is at its worst in our office, which is where we need the telephone most. There, of course, we can't use a cordless phone—no telephone accessories worked with our office system. At least that's what we thought. Then we heard about the *Hello Direct HelloSet Cordless* telephone headset, and wanted to give it a try.

The HelloSet Cordless consists of two pieces: a base unit that acts as a battery recharger, and the headset itself, which sits on the base unit when not in use. The system is connected to your telephone via the phone's handset—the handset plugs into the HelloSet's base unit, and a short cable supplied with the HelloSet connects that base unit to your telephone's handset jack. (If your PBX phone uses a 2-prong handset jack, you'll have to buy a $20 adapter from Hello Direct.)



CIRCLE 52 ON FREE INFORMATION CARD

The charcoal-colored base is about the size of a small desk telephone, and it is styled to look at home on your desk. The base charges the headset between uses, as well as charging a second battery.

The headset weighs about 7 ounces, and has a wide, comfortable, easily adjusted headband. Although the headset has only one earpiece, it's balanced reasonably well by the battery, which is on the opposite side of the headband, above the other ear. The microphone is mounted on a boom that can swing up over the head when it's not in use. The boom acts as a function switch as well. When it's stored up over the headband, the headset's power is turned off. When it's swung down to chin level, it's linked to the base unit on the 900-MHz band. When swung up half way, the microphone is muted—but you can still hear the party to whom you're talking. A volume control is located by the earpiece.

The base unit is styled to match a standard business telephone, although it's smaller. It acts as a recharger for the headset's battery, and it also stores—and recharges—a *second* battery, so you'll always have one ready. Although we liked the two recharging bays, we're not sure that we like the base unit as a whole. It's too big. We have too little desk space as it is, and find it hard to increase the required telephone real estate by more than 50%. Also, because of the way the headset mounts on the charging base—it just sits there instead of being held in place—the base must remain flat or the battery won't make sure contact. On a crowded (in other words, messy) desk, the unit often got tipped enough that the battery lost contact. Fortunately, an LED, which lights when the headset is properly mounted, should alert you to the problem. Two potentiometers let you adjust the input and output levels to match virtually any telephone.

The HelloSet Cordless is not a cordless telephone. To make or receive a call, you must be near your telephone. To make a call, for example, you must put the headset on, and then take your handset off the hook and dial as normal. When you're finished with the call, you have to hang up the phone as normal, and move the microphone boom out of the way to turn off the headset. To receive a call, you must also be at your phone so that you can pick up the handset. The HelloSet Cordless does not work with telephones where the dialing is done through the handset.

It seems to us that the HelloSet Cordless would be ideal for someone who spends a lot of time in his office, but who needs his hands to shuffle through papers or books—or use a computer keyboard—while on the phone. And having your hands free while you talk on the phone—and keeping your neck straight at the same time—is something we could get used to. ■

High-Touch Home Office

NAVIGATOR HD-40 OFFICE SYSTEM. From: Canon U.S.A., Inc., One Canon Plaza, Lake Success, NY 11042. Price: $2495.



CIRCLE 53 ON FREE INFORMATION CARD

There's no question that the home office has arrived. In fact, there are almost 20-million full-time home offices in the U.S. today—and there is someone working at home, whether part-time or full-time in almost a third of all American households. There are several types of home-office workers. Some are simply doing "homework" (tasks that couldn't be finished during regular office hours), some are self-employed or run small businesses from their homes, some work part-time or do freelance work on their own time, and others work full-time at home for an employer. Reflecting the variety in home-workers, there are many types of home offices. Sometimes the space consists of a few square feet carved out of a former closet or a corner of a bedroom, kitchen, or den; a spare bedroom might be pressed into office duty; and occasionally a garage, basement, or attic is converted to office space.

Whatever the differences might be between the types of workers, the jobs being done, and the type of space being used, almost every home office situation has two basic similarities. First, they must be stocked with equipment to meet the demands of a high-tech job market. "Information equipment" (as it's called by the Electronic Industries Association) includes personal computers, facsimile machines, telephones, answering machines, copiers, typewriters, calculators, and personal organizers. Second, in today's smaller houses, home offices are usually vying for floor space with the rest of the family's needs and hobbies—audio/video equipment, exercise gear, storage space, etc.—so size restrictions are the rule.

An obvious contradiction arises: How do home workers manage to squeeze all those electronic necessities into the tiny space allotted? *Canon* has come up with an elegant solution. The *Navigator HD-40* system integrates the functions of a facsimile machine, a telephone, a digital answering machine, a plain-paper copier, an image scanner, and personal computer into one compact unit. With bundled software designed to meet home-office and small-business needs, an ink-jet printer, and a 40-megabyte hard-disk drive, the Navigator is actually a "desktop office."

After using the Navigator in our **GIZMO** offices for the past few weeks, we realize that we can't provide details of each of the unit's functions in the space we have on these pages. (Canon requires seven full-length manuals, a quick-reference guide, an introductory booklet, and a video manual to fully explain its scope!) Instead, we'll give you a brief overview of what you can do with the Navigator, and some of our general impressions of it.

For a system that comes with all those manuals, the Navigator is remarkably easy to set up and start using. To a large extent, that is due to the video manual, an hour-long, step-by-step tutorial that leads you through the hardware setup and software installation with clear language and practical demonstrations. Anyone can get the system up and running—if they can lift the 36-pound main unit out of the box!

The telephone and handset, answering machine, fax, thermal printer and paper roll, 40-megabyte hard drive, 3½-inch floppy drive, and 10-inch monochrome CRT are all built into the main unit—so it's less surprising that it's somewhat heavy than that it measures only 14½ × 12¾ × 13¾ inches. The 9-inch black-and-white display is smaller than those that we're accustomed to, and so is the print on the screen. Despite that, and despite the fact that there's no contrast control (just brightness), the resolution is excellent for text, and the screen is easy to read. Peripherals include a compact Bubble Jet printer, a mouse, a full-size keyboard, and the cables needed to connect it all. Everything is a sleek, flat black.

The compact Bubble Jet printer, which emulates the IBM Proprinter and Canon's BJ-130e, outputs letter-quality text and graphics (360 × 360 dots per inch) on standard bond paper, envelopes, and even transparencies. It includes two internal fonts in three pitch sizes. A replaceable cartridge makes the printer virtually maintenance free, and because it's a non-impact printer, it's incredibly quiet. It is, however, equally slow and, as we discovered one rainy day, the ink is not waterproof.

As soon as the system is up, the main menu, which consists of 24 icons arranged in three rows of eight, appears on screen. To access any function, you simply touch the icon—the touch screen responds. Alternately, you can point and click with the mouse. Nine of those icons represent the Navigator's eight software application processes: Q&A for database and word processing, Publish It! (this one has two icons) for desktop publishing, Deluxe Paint II for drawing and painting, Word For Word to automatically convert document files from one format to another, Backup Pro/Optimize for hard-disk backup and reorganization tasks, Recover for data recovery, a typing tutorial called Mavis Beacon Teaches Typing, and a computer chess game called Chessmaster 2000. The other icons represent telephone, fax, DOS, copier, phone-book, and other basic functions such as "clean screen," which freezes the screen so that you can clean it (with the included wipes) without activating any of the functions—a frequent necessity when you're touching the screen all the time. A touch-screen "button" in the top left corner serves as an "escape" key. In the top right corner are two other "buttons"—Tel and Fax—used to go immediately into the memory-resident phone or fax modes while in the midst of another application.

The Navigator uses two microprocessors. An 8-MHz V50 runs the Navigator touch-screen environment and the phone/fax systems. A 10-MHz 8086-1 microprocessor runs standard DOS applications with IBM XT compatibility.

The answering machine, however, is not handled outside of DOS. In fact, it can be used only if the computer is on—but you can't use the Navigator for any other tasks when the answering-machine mode is on. We can understand why Canon did it that

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Instant Information

THE NEW GROLIER ELECTRONIC ENCYCLOPEDIA. From: Grolier Electronic Publishing, Inc., Sherman Turnpike, Danbury, CT 06816. Price: $395.

The promise has been implied all along: Once you get a computer, you'll have all the information in the world at your fingertips. Well, as the "computer revolution" became more of a real thing, and computers found their place in the offices, classrooms, and homes of regular people, it became obvious that the promise wasn't being fulfilled. People began to realize that the adage "garbage in, garbage out" was true, and that even though computers offered greater ease and speed in countless applications, unlimited access to information remained an elusive dream.

Now, however, a big change is coming about, thanks to CD ROM. The CD ROM, although introduced in the mid-1980's, is just now starting to move into the mainstream. Although it's long been considered an ideal tool for serious applications, it now seems that it can also be an ideal tool for families. The trend toward family use of CD-ROM was sparked by two factors. First, today's only slightly sophisticated consumers are accustomed to CD technology, thanks to audio compact discs, and many of them are also used to using computers for work or for game-playing. Second, relatively inexpensive CD-ROM add-ons for PC's have hit the market, along with an array of family-oriented software. That software includes the *1991 New Grolier Electronic Encyclopedia*.

The single CD-ROM disc contains all 21 volumes of the *Academic American Encyclopedia*, which you might find in the young-adult section of your local library. That includes 33,000 articles, over 2000 color illustrations and photographs, and—something not found in the library's tomes—audio excerpts.

What's the advantage of the CD-ROM version when compared to the traditional version? Well, one obvious advantage is its size. A single compact disc and a small instruction manual don't take up much room. The real advantage, however, doesn't become obvious until you use it.

Let's presume, for example, you want to research information on Jimmy Carter. In a standard encyclopedia, you'd probably go right to "Carter." In that article, there might be indications of other related articles to read. But if you want to find out about Jimmy Carter by using the Electronic Encyclopedia, you would simply enter "Jimmy Carter" at the Word Search menu. Within seconds, you would be presented with a list of 50 articles that contain the words "Jimmy Carter." Many of them contain only passing references to the president. But others contain information that is essential to get the overall picture of the Carter presidency.

In the standard encyclopedia, we probably wouldn't have looked in the article "Fuel" for information about Carter, but since it was on the list of 50 articles, we called it up by clicking on it with our mouse. (A mouse is supported, but not required.) We immediately were brought to the portion of the article that contained the reference: a section on the synthetic-fuel program initiated under Carter. We also might not have looked up "Panama Canal Zone" to get yet another side of the Carter presidency, in which he signed a treaty with Panama to return control of the Canal Zone to Panama in 2000.

Actually, the list of 50 articles isn't a complete list of all articles that reference Carter—there are really 54. But since the software allows lists containing a maximum of the 50 "most relevant" titles, we were greeted with a suggestion to narrow our search.

Narrowing the search is simple. The Word Search menu contains 4 lines for search entries. Since we have "Jimmy Carter" on the fist line, we can narrow the search by entering another word on the next line. If, for example, we enter "War," then the article list would be cut to eight entries that referenced both Jimmy Carter and war.

We thought that eight seemed like a lot—after all, Jimmy Carter's presidency was a peaceful one. Well, one article, "Neutron bomb," certainly seemed relevant. In another, "Eritrea," we learned that Carter was host to preliminary peace negotiations between secessionist rebels in that province and the Ethiopian government. What did George Meany have to do with Jimmy Carter and war? Well, it turns out that the labor leader was behind the Vietnam War effort and critical of some of Carter's economic programs. Since both words were in the same paragraph, the article came up on our list.

To broaden or to narrow the search to increase the likelihood of coming up with relevant articles, you have several search options. For example, you can call up articles if they have your search words anywhere within, or only if they have the words in the same paragraph. You can restrict the list only to those articles that have the words in the exact order in which you entered them, or you can specify a given maximum distance between the search words.

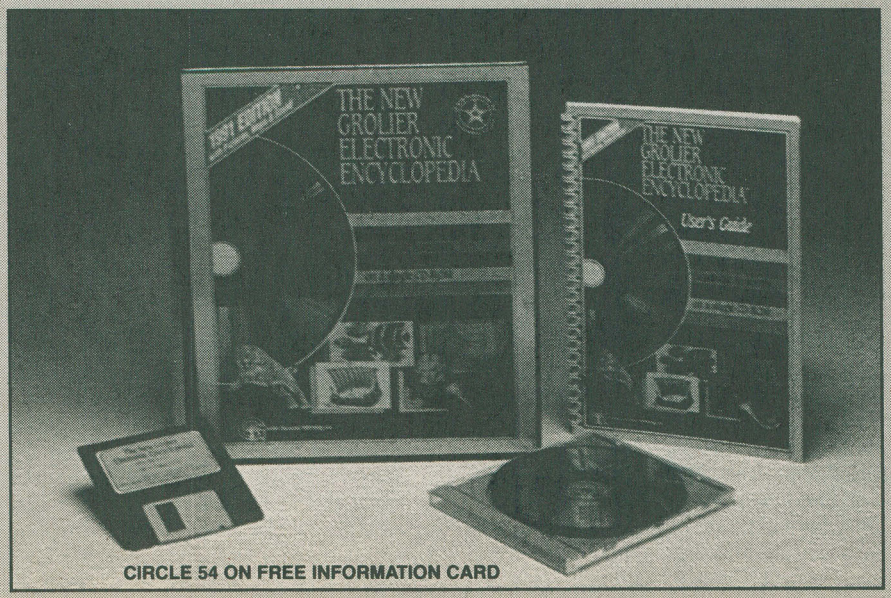
You can also enter words that you *don't* want the search function to find. For example, if you were doing a paper on the European arena of the Second World War, you might instruct it to search for articles about World War II, but *not* about Japan. The "or" logic operator is also supported, and the standard "*" and "?" wildcards are permitted.

Within articles, certain words appear in capital letters. Those are cross-references to articles that you can reference immediately simply by placing your cursor on the word and hitting the Enter key.

Standard encyclopedias, of course, can be fun to just *read*, even if you aren't researching anything in particular. Fortunately, the Electronic Encyclopedia doesn't take away any of that fun. Instead of searching for specific words in articles, you can simply use a Browse Titles function and scroll through an alphabetical list. At any time you can enter a word that you're interested in. You'll be brought to that title immediately. If that title doesn't exist, you'll be brought to the article alphabetically closest to your choice.

Some of us just like to look at the pictures. That's why Grolier included a Browse Picture Index function. There, you

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CIRCLE 54 ON FREE INFORMATION CARD



CIRCLE 55 ON FREE INFORMATION CARD

It's a DAD!

NEW-TRONICS MESSAGECOM DOOR ANSWERING MACHINE. Manufactured by: New-Tronics, Inc., 1501 Centre Street, Rapid City, SD 57701. Price: $199.95.

Calling cards—those cards, imprinted with one's name, used to be used by visitors in Victorian times to say "I just stopped by"—have gone out of style. Sometimes we wish they were still around—especially when we make unexpected stops and no one is home. We usually end up scrambling for some paper and a pen, and then trying to find a place to stick our message where it will be seen and where it won't blow away.

Well, just as telephone answering devices, or TAD's, solved the problem of unanswered telephones, a new product called the *MessageCom* from *New-Tronics* does the same for unanswered doors. When a visitor approaches your door, he'll see the "door-answering device," a small, beige box that measures about 4 × 3 inches, mounted on the door. Two buttons along the bottom edge of the unit are labeled to instruct the visitor what to do. One says, simply enough, "Push to hear message," while the other says "Push and hold to leave message."

On the inside of the door is mounted a second, larger unit, through which the outside sounds are heard. Three buttons along the bottom let you record an outgoing announcement, and use the device as an intercom instead of an answering machine.

MessageCom is supposed to work like this: A visitor comes to the door, and pushes the "hear message" button. Your voice is then played back saying something like, "We can't come to the door right now, but please leave a message." The visitor follows the instructions and leaves a message for you, which is recorded digitally for playback.

One of the benefits of such a setup is that you can use the door-answering machine just as you would use one for the telephone—to screen visitors. Leaving a message that you can't come to the door doesn't let the visitor know whether your home or out. If the message is from a delivery man or someone you want to see, you can simply go to the door and answer it. If it's from someone you don't want to see, such as a salesman, just let them leave a message.

The MessageCom can aiso be used as a standard intercom. For that mode, the Intercom button on the inside unit is turned on, and all sounds from the outside are heard. To communicate with the visitor, just press the Play/Talk button.

Although the MessageCom is reasonably easy to use, it's a little more difficult to install, mainly because the two pieces must be hard-wired together. The simplest installation is the one we described, with one piece mounted on the outside and the other on the inside of the door. Then, all you need to do is drill a hole for the wire that connects the units, and two holes for the bolts that secure the units to each other and to the door. Silicone sealant is needed around the outside unit for a water-tight seal.

It's also possible to mount the units separated by considerable distance—up to 1200 feet—as long as you have the required length of 6-conductor cable. The inside unit can be mounted on the wall, or even on a desktop using the rubber feet supplied. Templates suppled with the manual make the installation as painless as possible, and the hardware supplied should fit most installations. We can think of a couple of situations in which the long-distance setup would come in handy: when you live in the upstairs apartment in a two-family house and when you spend a lot of time in your basement workshop.

The MessageCom is powered by five Alkaline "D" cells, which should last about a year. When they have about a month's worth of life left, a "Bat" LED on the inside unit will light whenever any button is pressed.

The total message length, both incoming and outgoing, is 3 minutes, which doesn't sound like much but is actually sufficient. Additional incoming messages will replace the older ones. All messages are stored digitally—there are no tapes to wear out, and no mechanical parts to get hung up by the elements. Once the volume control is properly set, the audio quality is adequate.

The MessageCom works as claimed. The question we have is whether we can get *people* to use it correctly. The outside unit seems easy enough to operate, but it apparently intimidates some people. Some people will push the recording button, ignoring the clearly stated "push and hold," and we wouldn't be surprised if others simply walked away without even touching the unit.

One complaint we have is that if the unit is in the intercom mode, and the visitor presses the "Push to hear message" button, he won't hear anything. And you won't necessarily hear anything either, unless they use the "Push and Hold to Leave Message" button. And if the visitor correctly uses the message button, you won't necessarily hear it unless you're in the same room—no doorbell-type signal alerts you to the visitor.

Although the MessageCom isn't perfect, we like it nonetheless. Most homeowners don't really need it, but gizmo freaks will have fun with it. The most likely market for the MessageCom, we think, is the small, one-man business. Putting up a sign that says "Back in 15 Minutes" might work sometimes, but most customers won't come back. Given the opportunity to easily leave a message might rescue business that would otherwise be lost. We only wish that everyone *we* visit would have one so we wouldn't have to scramble for a pencil and paper. ■

GOLDEN SOUND RETRIEVER

(Continued from page 1)

ing from all directions, and cardioid microphones have a flat response for sounds coming from the sides and front, while ignoring rear sounds. A cardioid microphone might pick up reflected sounds, but when they are played back on speakers that are in front of you, you won't hear them at the right amplitude because your ears will treat them as they would any other sounds that come from in front. In other words, you'll lose any spatial cues that were recorded.

How can you restore those spatial cues? Well, according to Hughes, you just press the AK-100's SRS button.

In the original recording, the ambience information, including indirect (reflected) and side sounds, are contained primarily in the L – R or stereo-difference signal—the out-of-phase sum of the left and right channels. Those signals are processed by the SRS circuitry to bring back the missing spatial cues and directional information.

The stereo-difference is also used by other surround processors to create a third channel of ambience. One technique (matrix surround) uses the out-of-phase information directly to produce the third channel.

SRS, however, has to produce the ambience information using only two speakers. So after the stereo-difference signals are extracted from the left- and right-channel inputs, and before they're re-combined with the in-phase information, they're processed to bring back the missing spatial cues and directional information. The spatial information is also equalized to compensate for the ear's own direction-sensitive frequency response.

Another processing section in the SRS circuitry is a "directivity servo," which detects motion information—sounds that move from one channel to the other such as a passing car—and isolates it from stationary information so that it can be steered separately to its proper location.

Two controls, Space and Center, are used to govern most of the SRS effects. The Space control is in the stereo-difference signal-processing path, while the Center control is in the stereo-sum processing path. Essentially, Space controls the amount of SRS ambience in the output to vary the width of the sound stage. As you might have guessed, Center controls the amount of center (stereo-sum) information present in the output.

Additional controls include a Level potentiometer, a 3-D Mono button (to achieve a surround atmosphere with a mono input), and a Rev Trim button that reduces the amount of reverb present in a vocalist's voice. A Filter switch is used to reduce a rumbling noise that is heard on some program material. A Loop Sel button lets you select a second external audio input for processing.

The front-panel display meter is a series of LED's arranged in an inverted "T" to provide an indication of the center and space contents. A Bar/Dot selector lets you select between dot- and bar-mode displays, and a Display button lets you turn off the display—sure to be welcomed by people who find flashing meters distracting. A final control lets you select either processing or bypass modes.

So does all that processing work? The answer is yes, and no. When used with a video system, the effect is quite pleasing—especially when watching movies that are recorded in Dolby Stereo—but not perfect. For example, there's a scene in *Blade Runner* in which a futuristic flying craft enters the scene from the left rear, flies forward across the screen, and exits at the front (top) right. With a Dolby Pro Logic decoder, the sound does the same—you hear it behind you first. With SRS, it isn't quite behind you. To us, it sounded more like it was *beside* us. But the effect was good nonetheless. In simple stereo, the sound just goes from the left to right side of the screen.

When used with music, the effect is also quite pleasant. When the processing is switched out (and you're returned to stereo) the effect is at least as dramatic as switching between stereo and mono. The SRS processing widened the soundstage and significantly widened the "sweet spot" for acceptable stereo.

We did find one situation where SRS just didn't seem to work: an NFL game broadcast. We don't know how the stereo was being handled by CBS, but the AK-100 had trouble maintaining a constant volume level. A Pro Logic processor didn't have the same trouble—the center channel stayed constant. Reducing the Space level checked the shifting level.

It seemed a bit unfair to us to expect a two-channel SRS system to compete with a 5-speaker Pro-Logic setup. But we felt justified after reading a passage in the AK-100's manual that said, "such surround-type matrices are not able to play back material with any sense of REALISM." (Emphasis theirs.)

SRS does have the advantage of a much wider sweet spot, and it is much easier to adjust properly—despite the lack of any remote control that would let you adjust the processor from your listening or viewing position. But when compared to a properly adjusted Pro-Logic surround system, SRS comes up short. But not so short that we would write it off. It's a cinch to set up and it does dramatically improve the sound of stereo by restoring ambience that we didn't think was possible with two speakers. It seems like a pretty good compromise to our ears—particularly in situations where those extra speakers are unwelcome. ■

VCR: NEXT GENERATION

(Continued from page 2)

used. The result is not just less wasted time, but almost no missed action when switching between modes.

It didn't take long for us to get used to looking at the screen, instead of at the little buttons on the remote control, as we used the jog-shuttle to advance (or reverse) the tape at various speeds in search of a particular scene. We quickly memorized the location of one of the little buttons, however. Labeled Skip, and located just to the upper left of the jog shuttle, it speeds through 30 seconds of videotape—a time frame that directly corresponds to most commercials. Three to five taps of the Skip button neatly took us past each commercial break when watching tapes we'd made of network programming.

The SLV-585HF offers some other ways to search for particular points on a tape. It's possible to insert "index" marks on the tape during recording or normal playback by pressing the Index Mark button; an index mark is automatically inserted at the beginning of any recording. To search to an index mark, you call up the data screen and press the Index button. The words "index scan" come up on the television screen, and flash on the deck's LCD readout. The search is activated by turning the jog shuttle clockwise for a forward search or counterclockwise for a reverse search, and then releasing the dial. The tape fast-forwards (not in play mode), and when the index mark is encountered, it returns to play mode. The data screen flashes the words "index scan" and the number of the index mark; if it is the correct mark, you hit Play to watch from that point. Up to 19 index marks can be inserted on a tape. You can also scan for a particular mark (by number) or erase marks using the Index Erase key.

Of course, to playback or search, it helps to have some material actually recorded on the tape. With the SLV-585HF, you won't have any excuses for not making your own tapes. Programming couldn't be simpler, using the on-screen menu for timer recording, or the Quick Timer button (located only on the main unit's inside control panel) for immediate recording in 30 minute increments. The timer can be set to record eight events over one-month; in the event of a power outage of less than three hours duration, the programmed timer functions will remain in memory.

Although the SLV-585HF is quite easy to use, learning to use it is another matter. The manual, while not one of the worst we've seen, is needlessly complex, lacks a comprehensive overview of the unit's features, and contains at least one glaring error. We don't believe that the explanation of how to use the dual-mode shuttle ring belongs in the "Advanced Operation

Section," forty-odd pages into the manual, when that's the first control that any new owner is likely to play with. The very brief mention of the jog dial under "Basic Operations" heading could have been placed in an expanded overview section—along with something about using the Skip button to bypass commercials, something that those who are unfamiliar with the new generation of VCR's might not realize. They also might not intuitively realize that to cause the index display to appear on screen (which the manual says occurs by pushing the Index button), they must first push the Data Screen button on the remote control. Even worse, inexperienced consumers might believe the manual's instructions for searching for indexed points on the tape: "Turn the dual mode shuttle ring clockwise to locate the previous program or counter-clockwise to locate the program ahead." Obviously (to those who are comfortable and familiar with consumer electronics, at least), the ring is turned clockwise for programs ahead and counter-clockwise for previous programs.

Even disregarding that error, the manual was weakest when it came to explaining indexing. We had some difficulty getting the hang of it, and we like to think of ourselves as experienced when it comes to consumer electronics (we certainly have learned how to use quite a few more devices than the average consumer, and we don't suffer from electronics intimidation!). Yet it took us a while to interpret the vague directions and poorly labeled keys. First, we figured out that to be sure an index had been set when we pushed the Index Mark button we had to either rely on blind faith or push the Data Screen key for visual confirmation. We learned by trial and error that we couldn't be in play mode when searching for index marks, and that when a mark is found, the tape, which is searching at a high speed, must stop and rewind to that point on the tape. When trying to erase an index mark, we discovered (again on our own) that we had to wait until the tape had rewound to the exact mark. We still haven't figured out why the button used to scan for index marks is not labeled "scan" and grouped on the remote with the Mark and Erase buttons under the heading of Index.

Despite the illogical arrangement of those keys, the SLV-585HF expects you to give it only logical commands. To keep the user in line, it displays on-screen warnings whenever you try an illogical operation. For instance, if you try to set a timer recording with no tape in the well, "Please put in a cassette" appears on the screen. Trying to rewind a tape that's already at its starting point brings up "The tape is rewound." Other messages include "You cannot change channels, tape speed or input source during recording," "Please set clock," and "VCR is recording." Those messages can be quite helpful in reducing the frustration experienced by beginners who can't figure out what they're doing wrong.

The VCR also provides minimal editing capabilities, but it does include a Control-S input (for synchronized editing with a similarly equipped VCR) and an edit mode (which reduces the deterioration between successive generations of tapes). If editing is important to you, we'd suggest spending the extra $50 for the SLV-686, a sister model that includes a flying erase head for better editing.

Those of you who do far more video watching than video editing could save money by opting for the SLV-585HF, and not be missing a thing. Both picture quality and audio quality are quite good, the smooth transitions from stop to play are a delight, using the dual-mode shuttle is comfortable and easy, and (once you get past the bugs in the manual) the entire unit is a breeze to use. ■

HOME OFFICE

(Continued from page 4)

way. After all, if you're sitting at your computer working, you are available to answer the phone. But we sometimes prefer to let a TAD pick up the call so that we can screen it and interrupt our work only if it's important. We also don't like having to leave the system on overnight or over the weekend—basically, 24 hours a day, seven days a week—to have full answering-machine coverage. Even though the hard drive shuts itself off after a period of inactivity to save power, no screen-blanking is provided.

The answering machine does have a couple of convenient features. For instance, it can be programmed to call another line with a wake-up call every day. And, when it is activated, the Navigator can distinguish between phone and fax calls, and automatically routes incoming faxes to the fax function. If you're wondering where the answering-machine cassette tapes go, don't. They appear only on the screen. Messages are stored to disk (either hard or floppy). Faxes can be stored to disk as well and printed later (to either the Bubble Jet printer or the built-in thermal printer) or incorporated into other software for desktop publishing, etc.

When you're using the Navigator and answer the phone only to find that it's an incoming fax, you can enter the fax mode manually simply by hitting the Fax "button" on the upper-right side of the display. A fax screen appears, and you can opt to receive a printout of the fax or store it immediately to disk.

For outgoing phone calls, as soon as the receiver (which is located just to the left of the CRT) is lifted off the hook, the phone directory appears on the screen, covering the current application. Once you've input all your frequently-called numbers, speed dialing phone (or fax) calls is a snap. For outgoing faxes, a fax directory appears by pressing the fax icon at the upper right corner of the screen. It includes a "group" setting that lets you program a sub-directory with groups of people to whom you frequently send the same fax, and then send them all faxes with one command. Advanced fax functions—sending at preset times, polling, broadcasting, sending confidential faxes, sending a facsimile previously received to disk, attaching a cover sheet, faxing a document directly from an application program, and viewing and printing faxes received to disk—can be accessed by pressing the extended-fax icon on the main menu.

That gives you an idea of some of the advantages of an integrated machine. You can incorporate graphics received over the fax machine (or scanned in) into a desktop-publishing file, or make copies of faxes on thermal or plain paper. You can scan in a logo to create personalized stationary. The included software gives you even more flexibility, allowing you to manipulate files that are scanned in or created using various programs so that they are compatible with yet other programs. For instance, if you enjoy using the Navigator's built-in data base and word processor, Q&A, but everyone in your company's main office uses WordPerfect or one of the dozens of other popular word-processors, Word For Word Professional makes it easy to convert your files—including both text and formatting commands—to match. Other software also makes it possible to convert scanned image files or those received by the fax into different graphics formats for compatibility with various paint and desktop-publishing software.

You aren't limited to the included software, of course. Even with all of the included software installed, you still have 30 megabytes of free space left on the hard-disk drive to install your preferred programs. And, if you have a favorite word processor, but don't normally use a paint or desktop-publishing program, you can pick one from column A and two from column B—mixing and matching your software and the Navigator's. There is room on the main menu for several additional icons, so you can add custom icons for your favorite non-Navigator programs.

The Navigator brings all of the office equipment that most businesses need into a package that fits on even the smallest of desks. Although we don't think that it's always the most elegant solution—the answering machine is decidedly inelegant—and it is impossible to expand the Navigator with standard add-on cards, you'll be hard pressed to find equipment with equivalent functionality at the same price. You'll never find equipment that will be as easy to set up. ■

INSTANT INFORMATION

(Continued from page 5)

get a list of all of the thousands of pictures on the disc. Fortunately, they are broken down into categories such as "Aircraft," "Mammals," and the like. A host of maps are also contained on the disc, and a Browse Map Index is included.

The sounds included on the disc are a part of what makes the Electronic Encyclopedia a "multimedia" experience. Interestingly, there's no function to browse through the available sounds. As far as we could tell, however, all articles with sound also include a picture. When scrolling through the picture index, any picture with an accompanying sound has an asterisk next to it. Unfortunately, that's not pointed out in the manual.

When reading a given article, an accompanying sound byte is indicated at the bottom of the text, along with an indication to hit ALT-7 to retrieve the sound. So, when researching Abraham Lincoln for example, you can call up 33 seconds of his second inaugural address ("With malice toward none, with charity for all...").

We like the sound capability—it's something that we've never seen in an encyclopedia before. In many cases, it's not all that useful, though. Listening to an actor reciting 33 seconds of Lincoln's second inaugural address doesn't tell us too much that couldn't be expressed in text.

In other cases, sound is used more effectively. Hearing 33 seconds of Dr. Martin Luther King, Jr.'s "I have a dream" speech *does* tell you something about his powerful oratorical style. Another practical use for sounds is with bird calls. We, for example, have never seen an eastern bluebird, even though it's the state bird of New York. Maybe if we knew what it sounded like, we'd have an easier time in finding one. Fortunately, the eastern bluebird is one of the species that includes an associated sound byte—eight seconds or so of its calls.

Like traditional texts, you can insert "book marks" at locations where you want to return to without having to reconstruct your search. Since the encyclopedia is electronic, however, you can quickly store article text to a disk file or to a "note pad." You can also print the text out at any time—the entire article, a paragraph, or the current 12-line screen.

Although we used the PC version of the encyclopedia, a Macintosh version is also available. The basic requirements for the PC are: 512K RAM, a floppy disk drive, and a CD-ROM drive with audio outputs. For viewing photos and graphics, a VGA card and monitor are required.

While the New Grolier Electronic Encyclopedia is new now, it won't stay new for long. An annual update, however, is available for $125. Since it's likely that the encyclopedia will be used in schools, a teacher's guide is available for $49.

The new version of the Encyclopedia gives us a good idea of what the future has in store for research encyclopedias. We wonder how our kids will explain to their kids about the days before CD-ROM. We wonder if they'll believe that a set of encyclopedias once required a whole bookshelf, and researching a paper meant at least one trip to the library! ■

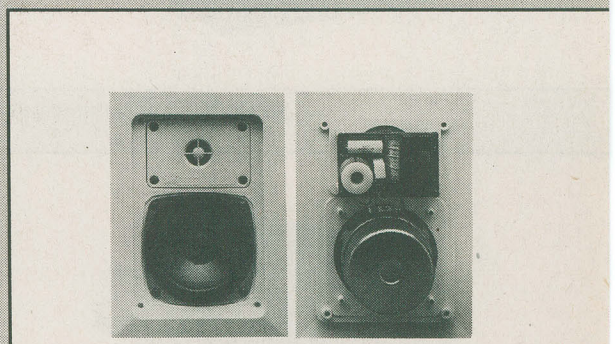
For more information on any product in this section, circle the appropriate number on the Free Information Card.

ELECTRONICS WISH LIST

In-Wall Video Speaker

In-wall speakers are nothing new, but there's something different about the *MV-30* from *Sonance* (961 Calle Negocio, San Clemente, CA 92672). The in-wall, two-way speaker is shielded to prevent the magnetic fields present in loudspeakers from interfering with your television's picture. The speaker can be installed alongside, or even abutting, a video monitor without degrading the monitor's picture quality. That makes it a good candidate for a center-channel speaker in a Pro Logic setup. It's small size also makes it well-suited for small dens, kitchens, or bathrooms. The full-range speaker has a frequency response of 65 to 20,000 Hz, ±2 dB, and a nominal impedance of 8 ohms. It requires a minimum of 5 watts and can handle up to 60 watts. Price: $310 per pair, including brackets and grilles.

CIRCLE 56 ON FREE INFORMATION CARD

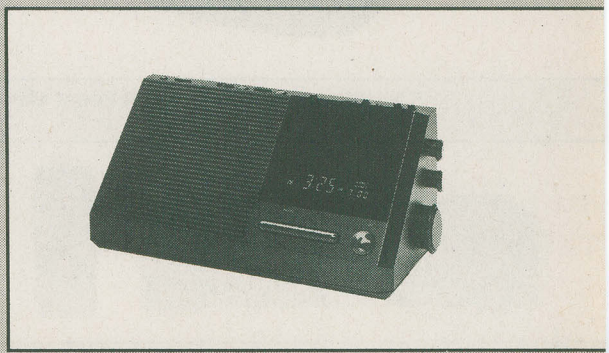


Sonance In-Wall Video Speaker

Gentle Alarm Clock

Can't stand to be awakened by a jarringly loud alarm? *Proton's* (5630 Cerritos Avenue, Cypress, CA 90630) *RS-325 Clock Radio* spares your ears—the alarm or radio can be set to increase gradually in volume over a five-second period. Two separate alarms can be programmed for different wake-up times. The black clock radio has bright controls and a fluorescent digital display that has an automatic light sensor that dims and brightens the display to compensate for ambient light. Designed to take up as little night-stand space as possible, the RS-325 features a slanted front panel that makes it easier to read the display and to hear the speaker. Price: $110.

CIRCLE 57 ON FREE INFORMATION CARD



Proton Clock Radio

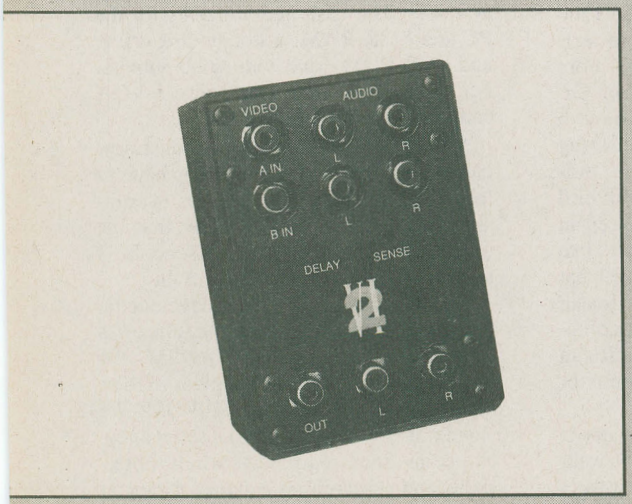
Large-Button Telephone

For people with sight, hearing, or dexterity limitations, *Lonestar* (Division of Planned Technologies, Ltd., 485-31 South Broadway, Hicksville, NY 11801) *model 888* telephone features extra-large buttons and a volume-boost control. The phone has a last-number redial button, user-replaceable modular cords, and three ringer-volume levels. It comes in white and can be mounted on a wall or a desktop. Price: $49.95.

CIRCLE 58 ON FREE INFORMATION CARD

ELECTRONICS WISH LIST

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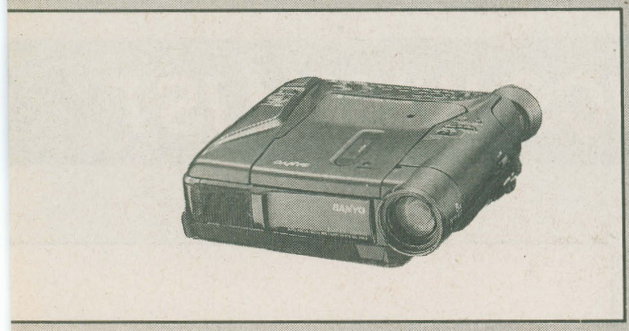


R.F. Engineering A/V Switches

Automatic A/V Switches

As today's home-entertainment systems get increasingly complex, it's not unusual to have a setup in which both a laserdisc player and a VCR must be connected to a monitor, and the hi-fi and the surround-sound system share a single power amplifier. Not only does the wiring get complex, but the equipment can become difficult to operate—that becomes apparent when you try to teach non-technical family members how and when to switch between two sources. To avoid getting frantic phone calls while you're at work ("I can't make the TV come on and the kids want to watch Sesame Street!"), try using one of the *VI Series* of automatic A/V switches from *R.F. Engineering, Inc.* (9215 Lowell Blvd., Westminster, CO 80030). Each VI unit allows two different video devices to be connected to one monitor, and detects which source is delivering a signal and routes the signal to the monitor. A sensitivity adjustment allows the VI to filter out noise that can cause erratic switching, and a delay adjustment is used to prevent switching during the pause between tracks on a CD. The A/V switches can also run on 12 volts DC for automotive or marine applications. Price: $89.95 with RCA connectors or $119.95 with S-Video connectors.

CIRCLE 59 ON FREE INFORMATION CARD

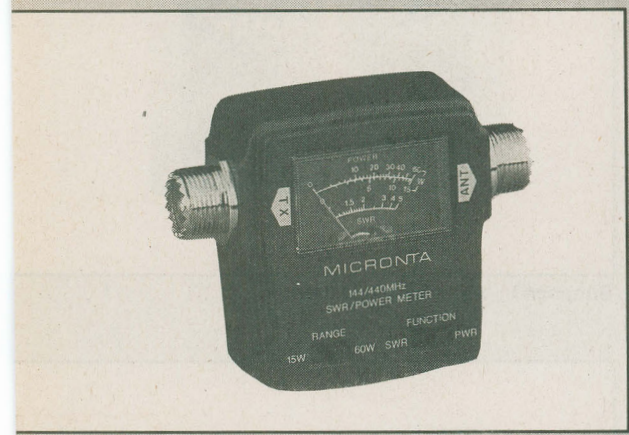


Sanyo Horizontal Camcorder

Horizontal Camcorder

The horizontal shape of *Sanyo's* (21350 Lassen Street, Chatsworth, CA 91311-2329) *VMES77* horizontal-design 8mm camcorder makes one- or two-handed operation easier, providing better stability and access to all controls. That design also results in less bouncing when you wear the camcorder suspended around your neck, and fits better in a briefcase. Fuzzy logic technology—which imitates human thinking by considering not just yes and no, but all sorts of "maybe's"—promises to make the camcorder's automatic iris, white balance, and focusing faster and more accurate. The VMES77 has an 8:1 variable-speed zoom lens and an inner-focus lens for close-ups. An adjustable pull-out viewfinder can be adjusted up to a 90° angle. Other features include an on-screen menu, a switchable electronic shutter, 4-lux low-light capability, a title-insertion function, and a flying erase head. Price: $889.99.

CIRCLE 60 ON FREE INFORMATION CARD

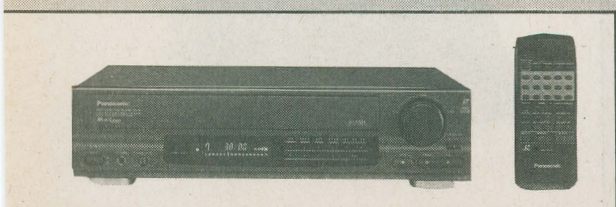


Radio Shack Ham Radio SWR/Power Meter

SWR/Power Meter

Amateur radio hobbyists are well aware of how important proper antenna tuning is. The *Micronta Ham Radio SWR/Power Meter (Cat. no. 19-320) from Radio Shack* (700 One Tandy Center, Fort Worth, TX 76102) can be used to optimize antenna settings for handheld transceivers as well as mobile or fixed ham radios. It is specifically designed for use on the popular 2-meter (144-MHz) and 70-cm (440-MHz) amateur-radio bands. The device's low insertion loss allows it to remain connected at all times, and its wide-range accuracy lets the user measure power up to 60 watts. Price: $39.95.

CIRCLE 61 ON FREE INFORMATION CARD



Panasonic Multi-Disc Player

Multi-Disc Player

Besides full-size LD's and standard 5-inch CD's, *Panasonic's* (One Panasonic Way, Secaucus, NJ 07094) *LX-101 Multi-Laserdisc Player* is compatible with eight-inch LD's, five-inch CD-videos (CDV's), and three-inch CD singles. The front-panel shuttle-dial makes it easy to scan and accurately find a particular scene or frame. A digital time-base corrector estimates and compensates for horizontal distortion to help eliminate jitter. The unit also digitally separates the luminance and chrominance signals of a video source to help prevent streaking and dot crawl. Audio quality is ensured with a one-bit D/A conversion system, and stereo outputs that allow the unit to be connected to a surround-sound system and external speakers for the home-theater experience. While it lacks a shuttle dial, the 38-key remote control can be used to command all major functions. Price: $600.

CIRCLE 62 ON FREE INFORMATION CARD

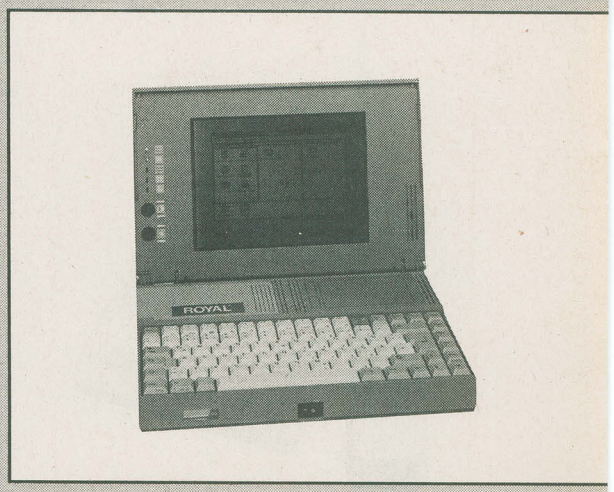
For more information on any product in this section, circle the appropriate number on the Free Information Card.

ELECTRONICS WISH LIST

Mousy Notebooks

All three of *Royal Consumer Business Products'* (765 U.S. Highway 202, Somerville, NJ 08876-1289) notebook personal computers feature a touch-control mouse pad built into the base unit. The screen cursor is easily maneuvered with the touch of a stylus or finger on the pad, providing full use of both traditional and advanced graphic environments, such as Windows and GeoWorks Ensemble. *Notebook S20* is based on Intel's 80386-SX and includes a 60MB hard drive. A 16-MHz, 80286-based unit, the *Notebook V16*, is available with a 40MB hard drive. Both models also feature a backlit, paper-white, VGA-compatible display with 640 × 480 graphics resolution. Their 2MB of RAM is expandable to 6MB using user-installable expansion cards; further expansion is possible by attaching the docking module that houses two full-size AT expansion cards and a standard 5¼-inch floppy drive. The entry level 286-based *Notebook A12* runs at 12 MHz with 1MB of RAM (expandable to 5MB) and a 20MB hard drive. It has a backlit CGA-compatible LCD readout. All three units feature a 3½-inch floppy-disk drive, serial and parallel ports, connectors for external keyboard, mouse, and VGA monitor; and slots for a modem or fax board. Each weighs less than 6½ pounds with the NiCad battery pack. Prices: A12, $3499; V16, $3999; S20, $4999.

CIRCLE 63 ON FREE INFORMATION CARD



Royal Notebook PC's

Mini Loudspeaker System

For those who prefer their speakers to be heard but not seen, the 10½-inch-high by 7-inch-wide *SL250* is a two-way mini loudspeaker system that offers "full-range performance and produces an image with outstanding depth, height, and width," according to *Signet* (4701 Hudson Drive, Stow, OH 44224). The speaker's filter alignment optimizes bass-to-volume ratio for excellent low-frequency response and improves the speaker's low-frequency transient response and power-handling ability. The speaker has a 5½-inch paper-cone woofer and a ¾-inch metallized polycarbonate dome tweeter, cooled with ferrofluid. It is finished in black woodgrain vinyl. Price: $150 each.

CIRCLE 64 ON FREE INFORMATION CARD



Signet Mini Loudspeaker System

Audio/Video Care Products

Your electronics gear is more likely to keep running smoothly if it's kept clean, and *Bib America* (P.O. Box 27682, Denver, CO 80227) offers several products with that in mind. For the videophile, *Pushbutton VHS Video Head Cleaner model VE-40B* automatically applies the correct amount of cleaning fluid to the cassette's non-abrasive cleaning material, which runs through the machine and cleans the entire tape path. The *model A-655 Compact Disc Restorer Polish* has a metered spray applicator containing an ozone-safe, non-abrasive formula and an optical-grade polishing cloth. The formula removes light scratches and foreign substances from the disc's surface and provides anti-static protection. The *Audio Cassette Care System model A-632/A* consists of a specially designed head- and capstan-cleaning cassette, an applicator of tape-cleaning fluid, and a compact cleaning brush, all used to remove sound-contaminants from audio-cassette players and decks. Prices: From $17.95 to $24.95.

CIRCLE 65 ON FREE INFORMATION CARD

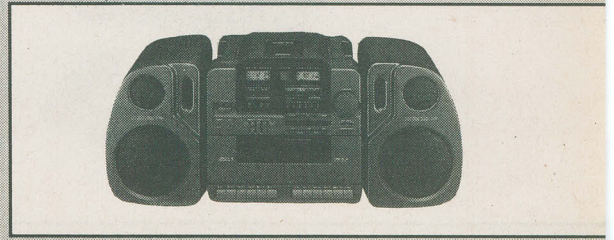


Bib's Audio/Video Care Products

Travelling Music System

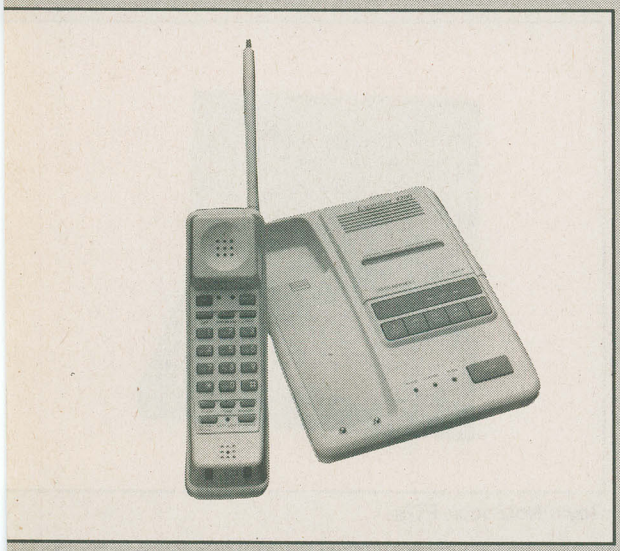
To provide music wherever you roam, *Casio, Inc.* (570 Mt. Pleasant Avenue, P.O. Box 7000, Dover, NJ 07801) offers the *model CD-1050* portable AM/FM stereo dual-cassette recorder with a programmable CD player. For stationary use, the 2-way, four-speaker system is detachable. The unit offers 12 station presets, auto-reverse in the playback mode, a three-beam laser-pickup CD player, a four-band graphic equalizer with three-step preset, and a remote control that operates all major functions. Price: $369.95.

CIRCLE 66 ON FREE INFORMATION CARD



ELECTRONICS WISH LIST

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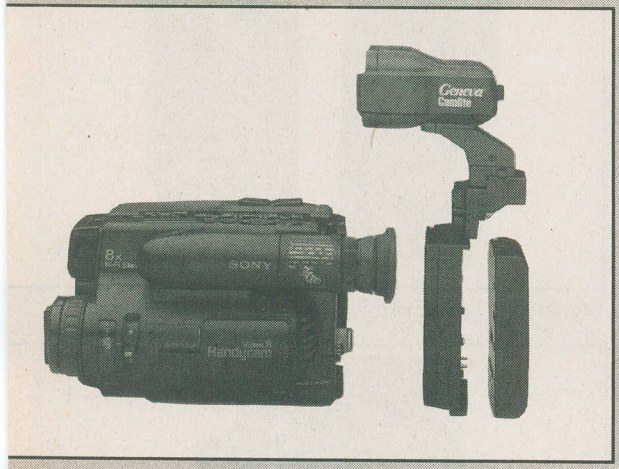


Northwestern Bell Cordless Phone/TAD

Cordless Phone and TAD

Offering the freedom of movement of a cordless phone—and the freedom from answering the phone at all provided by an answering machine—*Northwestern Bell Phones'* (9394 West Dodge Road, Suite 100, Omaha, NE 68114) *Excursion 4200* combines the two in one unit. The cordless phone has a rubber antenna, 10-channel accessibility, two-channel paging, an intercom, 10-number memory, and digital security. The answering machine provides a digital outgoing message and three programmable security codes, along with the basics—memo record, call screening, toll saver, two-way record, and beeperless remote. In addition, the Excursion 4200 features "ID Bell" for call selection, which allows the user to program different ringing tones for caller identification. Price: $299.99.

CIRCLE 67 ON FREE INFORMATION CARD



Geneva Camlite

Camcorder Light

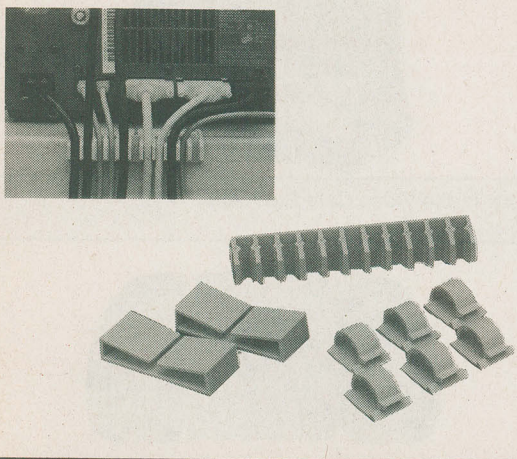
No, it's not a low-calorie camcorder. But by turning on and off with the camcorder, the *Camlite Auto On/Off* camcorder light extends battery life up to 25%. The light, from *Geneva Group* (9909 south Shore Drive, Plymouth, MN 55441), uses the battery that's supplied with the camcorder, and adds little weight to a compact camera. Three models are available, to accommodate JVC and Hitachi Palmcorders and Sony 8mm camcorders. Each model has a removable light, but the adaptor can be left mounted to the camcorder. The Sony model offers a light that's adjustable for greater viewing ease. Price: $89.95.

CIRCLE 68 ON FREE INFORMATION CARD

LCD Projector

When it comes to projection TV's, brightness is as important as size. *Sharp Electronics Corporation* (Sharp Plaza, Mahwah, NJ 07430-2135) has introduced a step-up model to their XV-100 (reviewed here in May, 1991). The *XBV-I20ZU* features an enhanced optical system, making its 100-inch picture about 70% brighter than that of the earlier model. The new unit is also about 20% smaller and lighter than its predecessor. The portable unit can be is easy to set up, and its variable zoom lens allows the image to be adjusted from 20 to 100 inches. By connecting the XV-120ZU to any standard or S-VHS video source and an existing audio system, a home-theater system can be created. Price: $3995.

CIRCLE 69 ON FREE INFORMATION CARD



Curtis Cable Organizers

Cable Organizers

If you've got an unwieldy tangle of wires and cords from your computer hanging behind your desk, and an even worse mess in your entertainment system, *Curtis Manufacturing Company's* (30 Fitzgerald Drive, Jaffrey, NH 03452) *Cable Organizers* could help. The kit includes one 10-slot cord manager with recessed label slots, two bundler clips to group loose cables safely to the wall or floor, six runner clips, and ten blank peel-and-stick labels. The organizers install quickly with self-adhesive mounting strips. The custom labeling capability makes it easy to identify cables—and avoid unplugging the wrong cord by mistake. Price: $9.95.

CIRCLE 70 ON FREE INFORMATION CARD

Cordless Headphones

What do you do when you want to sleep but your wife wants to watch every *Tonight Show* until Johnny Carson retires? *Arkon Resources* (11627 Clark Street, Suite 101, Arcadia, CA 91006) is offering a cordless infrared headphone system that just might save your marriage. The *IR-500* is specifically designed for private, comfortable listening while watching TV, without disturbing other family members. A microphone adapter makes it compatible with every television. Price: $129.

CIRCLE 71 ON FREE INFORMATION CARD

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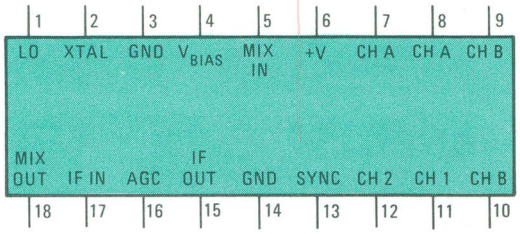
All will contain the type of information electronics hobbyists need, but sometimes must search to find. With *FactCards,* you can find that information in a hurry.

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Popular Electronics

196 Popular Electronics FactCard — LM1872 : Radio Control Receiver/Decoder

LM1872



FEATURES
- Four independent information channels; two analog and two digital
- Completely self-contained
- Minimum of external parts
- Operation from 50 kHz to 72 MHz
- Highly selective and sensitive superhet design
- Operates from four 1.5V cells
- Excellent supply noise rejection
- 100 mA digital output drivers
- Crystal controlled
- Interfaces with standard hobby servos

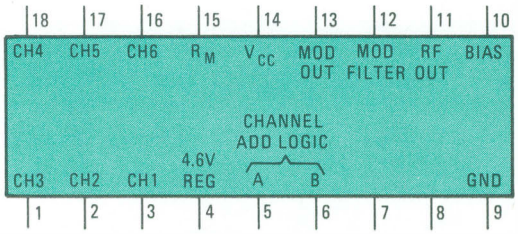
APPLICATIONS
- Toys and hobby craft
- Energy saving, remotely switched lighting systems
- Burglar alarms
- Industrial and consumer remote data links
- IR data links
- Remote slide projector control

ABSOLUTE MAXIMUM RATINGS
If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	7V
Package Dissipation	1600 mW
Voltage @ Pin 7, 8, 9, 10, 11 or 12	V+
Operating Temperature Range	−25°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C

197 Popular Electronics FactCard — LM1871 : RC Encoder/Transmitter

LM1871



GENERAL DESCRIPTION
The LM1871 is a complete six-channel digital proportional encoder and RF transmitter intended for use as a low power, non-voice, unlicensed communication device at carrier frequencies of 27 MHz or 49 MHz with a field strength of 10,000 μV/meter at 3 meters. In addition to radio controlled hobby, toy and industrial applications, the encoder section can provide a serial input of six words for hard wired, infrared or fiber optic communication links. Channel add logic is provided to control the number of encoded channels from three to six, allowing increased design flexibility. When used with the LM1872 RC receiver/decoder, a low cost RF linked encoder and decoder system provides two analog and two ON/OFF decoded channels.

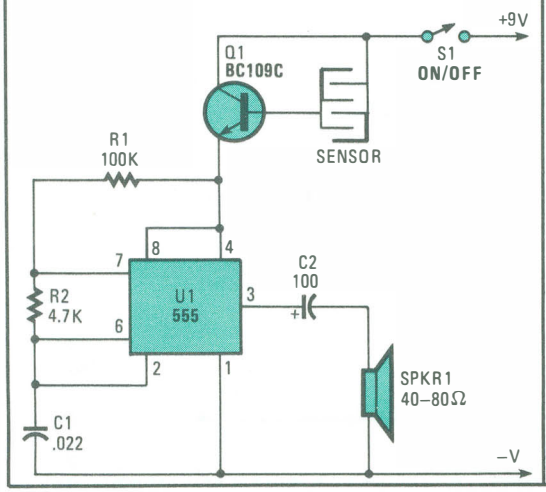
FEATURES
- Low current 9V battery operation
- On-chip RF oscillator/transmitter
- One timing capacitor for six proportional channels
- Programmable number of channels
- Regulated RF output power
- External modulator bandwidth control
- On-chip 4.6V regulator
- Up to 80 MHz carrier frequency operation

ABSOLUTE MAXIMUM RATINGS
If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

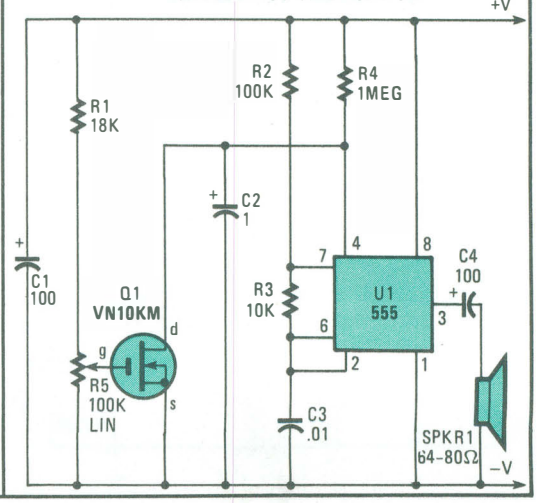
Supply Voltage	16V
DC Current Out of Pin 4	10 mA
DC Current Out of Pin 13	25 mA
Package Dissipation	1600 mW
Pin 4 Externally Forced	6V
Operating Temperature Range	−25°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C

198 Popular Electronics FactCard — APPLICATION CIRCUITS

WATER ACTIVATED ALARM



BATTERY VOLTAGE MONITOR



196 Popular Electronics FactCard — LM1872 : Radio Control Receiver/Decoder

DC ELECTRICAL CHARACTERISTICS

Parameter	Conditions	Typ	Units
Supply Voltage	Functional for V_{IN} = 100μV	6	V
Supply Current	CH A & B Off	13	mA
	CH A & B On	27	mA
V_{BIAS}	@ Pin 4	2.1	V
Sync Timer Threshold	@ Pin 13, Going from Low to High Voltage	V+/2	V
DIGITAL CHANNELS A AND B			
Saturation Voltage	@ Pins 7 & 9, R_L = 100Ω	0.4	V
Saturation Resistance	@ Pins 7 & 9	7	Ω

Parameter	Conditions	Typ	Units
Source Current	@ Pin 8 & 10, $V_{Pin\ 8\ \&\ Pin\ 10} \leq$ 1V		mA
Collector Pull-Up Resistance	Pin 7 & Pin 9 to V+	10	kΩ
Emitter Pull-Down Resistance	Pin 8 & Pin 10 to GND	10	kΩ
ANALOG CHANNELS 1 AND 2			
Saturation Voltage	@ Pins 11 and 12, R_L = 2kΩ	0.45	V
Saturation Resistance	@ Pins 11 & 12	160	Ω
Collector Pull-Up Resistance	Pin 11 & Pin 12 to V+	10	kΩ

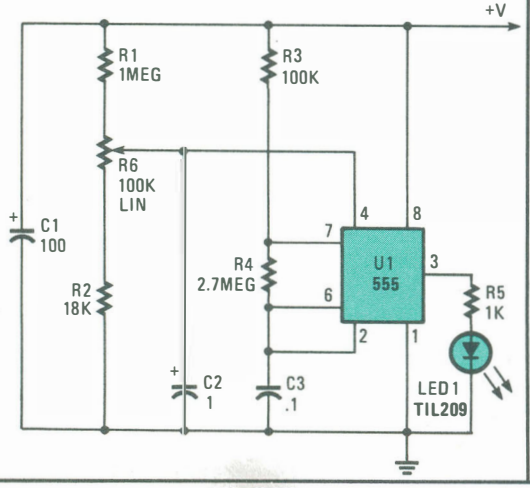
197 Popular Electronics FactCard — LM1871 : RC Encoder/Transmitter

ELECTRICAL CHARACTERISTICS T_A = 25°C, V_{CC} = + 9V

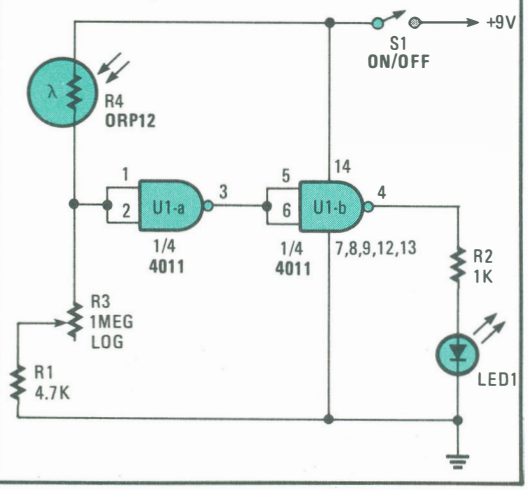
Symbol	Parameter	Conditions	Typ	Units
Encoder Section, Close S1, S2, S4 Open S3				
V14	Supply Voltage		9	V
I_{14}	Supply Current	Encoder Only	14	mA
V4	Reference Voltage		4.8	V
t_f	Frame Time	$t_f = R_F C_F + 0.63 R_{MOD} C_T$	9.5	ms
t_m	Mod Time	$t_m = 0.63 R_{MOD} C_T$	0.5	ms
t_{ch}	Channel Time	$t_{ch} = 0.63 R_{CH} C_T$	0.5	ms
t_s	Sync Time, T_x Channels 1-6	Close S1, Close S2	3.5	ms
t_s	Sync Time, T_x Channels 1-5	Open S1, Close S2	4.5	ms
t_s	Sync Time, T_x Channels 1-4	Close S1, Open S2	5.5	ms
t_s	Sync Time, T_x Channels 1-3	Open S1, Open S2	6.5	ms
Δt_n	Supply Rejection, $t_m + t_{CH}$	ΔV_{CC} = 6V to 12V	0.1	%/V
ΔV13	Encoder Output Swing		3.8	V_{P-P}
ΔV12	Mod Filter Output Swing		3.8	V_{P-P}
I_{12}	Mod Filter Source/Sink Current		0.5	± mA
$R_{IN(8)}$	Pulse Timer Input Resistance		27	MΩ
$I_{TH(7)}$	Frame Timer Threshold Current		0.1	μA
$I_{LEAK(15)}$	Mod timer Leakage Current	Pin 15 to 0V	0.01	μA
$V_{SAT(15)}$	Mod timer Saturation Voltage	I_{15} = 2 mA, (V4–V15)	120	mV
$I_{LEAK(CH)}$	Channel Timer Leakage Current	Pines 1, 2, 3, 16, 17 18 to 4.6V	0.06	μA
$V_{SAT(CH)}$	Channel Timer Saturation Voltage	I_{CH} = 2 mA	120	mV

198 Popular Electronics FactCard — APPLICATION CIRCUITS

SUPPLY VOLTAGE MONITOR



ENLARGER EXPOSURE METER



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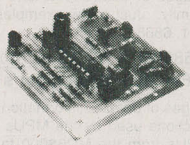
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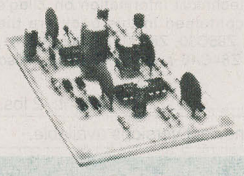
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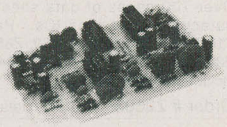
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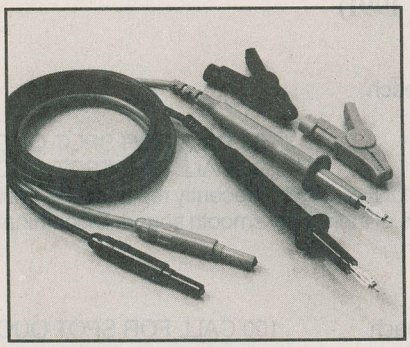
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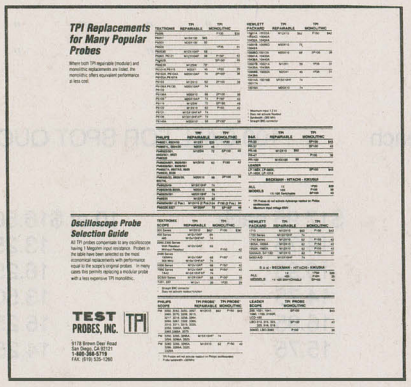
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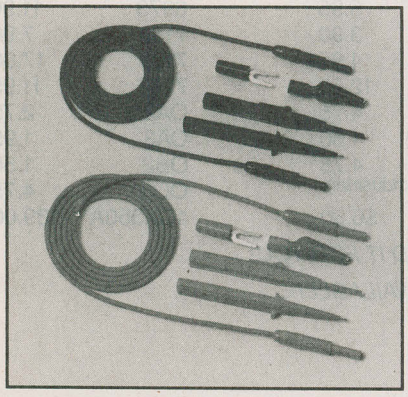
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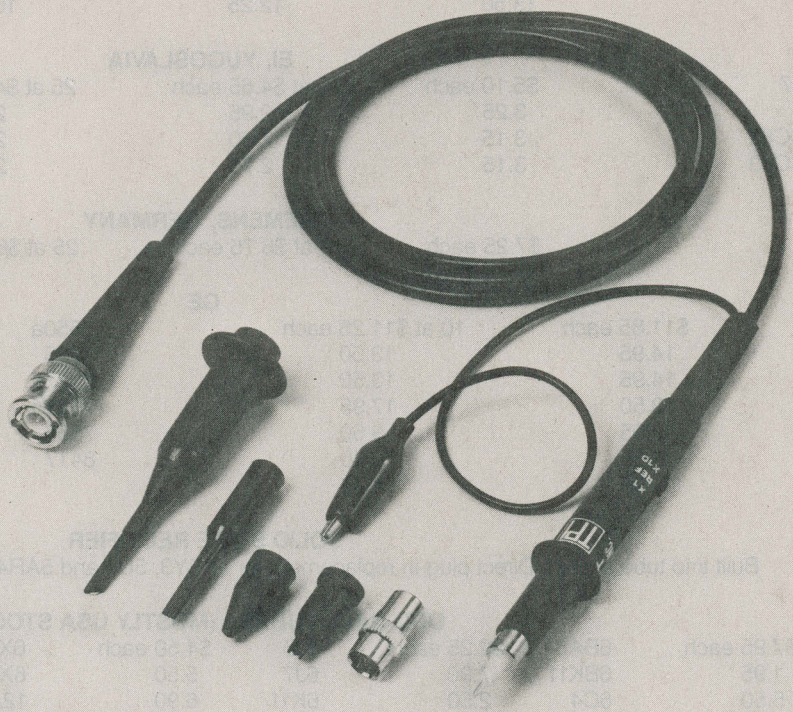


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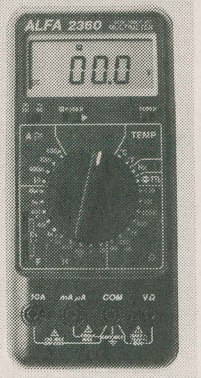
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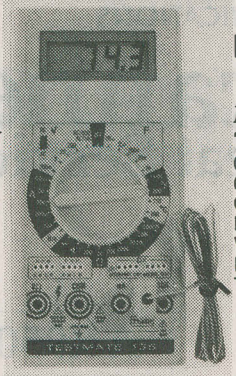
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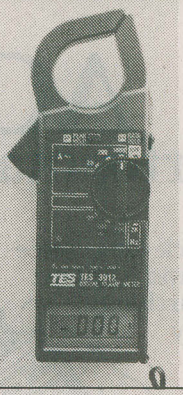
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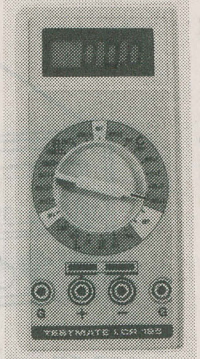
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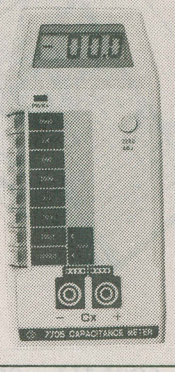
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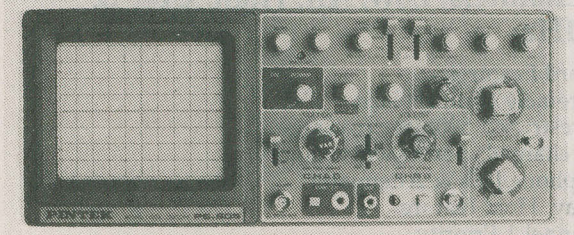
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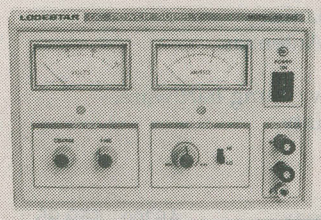
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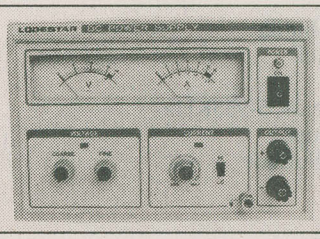
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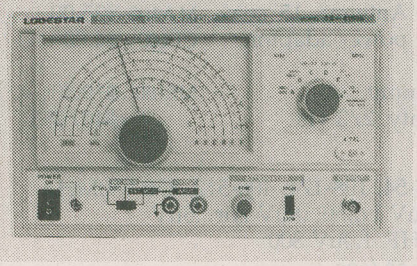
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Output: 5mV-20Vp-p
1% distortion
DC offset ± 10V



RF SIGNAL GEN./COUNTER SG-4162AD $239.95

Frequency counter 1Hz -150MHz
Sensitivity <50mV
For internal and external sources

AUDIO GEN./COUNTER AG-2603AD $239.95

Frequency counter 1Hz-150MHz
Sensitivity <50mV
For internal and external sources

FUNCT. GEN./COUNTER FG-2102AD $239.95

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Feature TTL and CMOS output

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AR1000 $429

1000 Channels. 8-600MHz, 805-1300MHz

Standard Features:
- Extremely compact size.
- Continuous coverage (except UHF TV 600-805)
- Antenna attenuator switch, 10db.
- Manual tuning knob.
- Earphone jack, 3.5mm.
- AM, FM and wide band FM tuning modes.
- Backlighted LCD display.
- 10 Scan Banks, 10 Search Banks.
- Selectable Priority Channel.
- Delay, Hold Features.
- Selectable Search Increments, 5-955KHz.
- Permanent memory backup.
- 4 AA Ni Cad batteries included.
- AC adaptor/charger.
- Carry Case.
- Cigarette Lighter Charger.
- Belt Clip.
- Earphone.

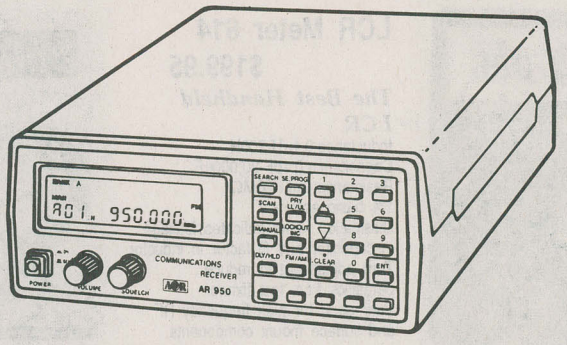
Options:

External Speaker. Mobile Mount.	MS190	$19.50
Extended Warranty. 2/3 yrs		$45/$55

Specifications:

Coverage:	8-600, 805,1300MHz
Sensitivity:	.35uV NFM, 1.0uV WFM, 1.0AM
Speed:	20 ch/sec. scan. 40 ch/sec. search
IF:	561.225, 58.075, 455KHz or 10.7MHz
Increments:	5 to 955KHz selectable/ 5 or 12.5 steps.
Audio:	.4 Watts
Power:	Input 9 - 13.8 V. DC
Antenna:	BNC
Display:	LCD
Dimensions:	6 7/8H x 1 3/4D x 2 1/2W. 12oz wt.

AR950 $239



100 Channels. Low, Air, High, UHF & 800MHz.

Standard Features:
- Extremely compact size.
- Unrestricted 800MHz coverage.
- 100 channels permanent memory
- Earphone Jack & Attenuator.
- Delay, Hold features.
- Channel 1 Priority.
- 5 Scan Banks, 5 Search Banks.
- Telescopic and Flexible Antennas w/ BNC connector.
- AC & DC Power cords w/ mtng hardware.
- One Year Limited Warranty.

Options:

Base type antenna 25 to 1000MHz w 50'coax.	AS300	$59.95
Mag Mnt Mobile Antenna. 15' coax.	MA100	$25.00
Cigarette Lighter power adaptor.	CP100	$4.00
External Speaker with mobile mount.	MS100	$19.50
Extended Warranty. 2/3 yrs		$40/$55

Specifications:

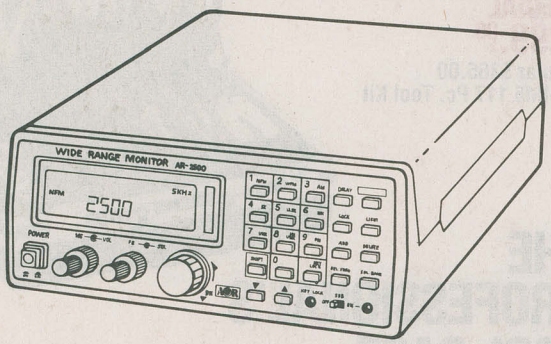
Coverage:	27-54, 108-174, 406-512, 830-950MHz
Sensitivity:	.4uV Lo,Hi. .8uV Air. .5uV UHF. 1.0uV 800
Scan Speed:	15 ch/sec.
IF:	21.4MHz, 455KHz
Increments:	10,12.5,25,30
Audio:	1W
Power:	12.8VDC, 200MA
Antenna:	BNC
Display:	LCD w/backlight
Dimensions:	2 1/4H x 5 5/8W x 6 1/2D. 14oz wt.

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ACE COMMUNICATIONS

AR2500 $499



2016 Channels. 1 MHz to 1500 MHz

Standard Features
- Continuous coverage
- AM, FM, wide band FM, & BFO for SSB, CW.
- 64 Scan Banks.
- 16 Search Banks.
- RS232 port built in.
- Includes AC/DC pwr crd. Antenna, Mntng Brckt.
- One Year Limited Warranty.

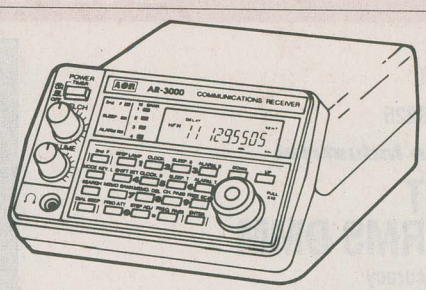
Options:

Earphone.	EP200	$2.00
External Speaker. Mobile Mount.	MS190	$19.50
Extended Warranty. 2/3 yrs.		$65/75
Mobile Mounting Bracket.	MM1	$14.90
RS232 Control Package (software & cable) offers spectrum display and database.	SCS2	$295.00

Specifications:

Coverage:	1 MHz - 1500MHz
Sensitivity:	.35uV NFM, 1.0uV WFM, 1.0AM/SSB/CW
Speed:	38 ch/sec. scan. 38 ch/sec. search
IF:	750.00, 45.0275, 5.5MHz 455KHz
Increments:	5,12,5,25 KHz
Audio:	1.2 Watts at 4 ohms
Power:	Input 13.8 V. DC 300mA
Antenna:	BNC
Display:	LCD, backlighted.
Dimensions:	2 1/4H x 5 5/8W x 6 1/2D Wt. 1lb.

AR3000 $995



400 Channels. 100KHz to 2036MHz.

Standard Features:
- Extremely compact size.
- Continuous coverage
- Attenuation Programmable by Channel.
- Manual tuning knob.
- Tuning increments down to 50Hz.
- AM, FM, wide band FM, LSB, USB, CW modes.
- Backlighted LCD display.
- 4 Scan and Search Banks, Lockout in Search.
- 4 Priority Channels.
- RS232 control through DB25 connector.
- Delay, Hold Features.
- 15 band pass filters, GaAsFET RF amp.
- Sleep and Alarm Features.
- AC adaptor/charger. DC power cord.
- Telescopic Antenna.

Options:

Earphone.	EP200	$2.00
External Speaker. Mobile Mount.	MS190	$19.50
Extended Warranty. 2/3 yrs.		$65/75
Mobile Mounting Bracket.	MM1	$14.90
RS232 Control Package (software & cable) offers spectrum display and database.	SCS3	$295.00

Specifications:

Coverage:	100KHz - 2036MHz
Sensitivity:	.35uV NFM, 1.0uV WFM, 1.0AM/SSB/CW
Speed:	20 ch/sec. scan. 20ch/sec. search
IF:	736.23, (352.23) (198.63) 45.0275, 455KHz
Increments:	50Hz and greater
Selectivity:	2.4Khz/-6db (SSB) 12KHz/-6db (NFM/AM)
Audio:	1.2 Watts at 4 ohms
Power:	Input 13.8 V. DC 500mA
Antenna:	BNC
Display:	LCD
Dimensions:	3 1/7H x 5 2/5W x 7 7/8D Wt. 2lb 10oz.

To Order Call 1•800•445•7717

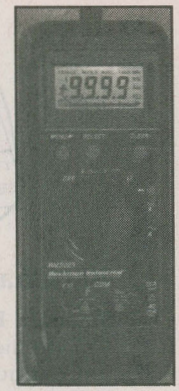
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Beckman Industrial



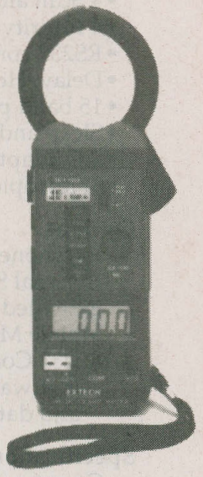
4 DIGIT TRUE RMS DMM

- 0.25 % accuracy
- 41 segment analog bargraph
- 3-year warranty

Full-function, auto-ranging DMM with 4 digit, 10,000 count resolution measures DC voltage and current, resistance and true RMS AC voltage and current. (It measures DC voltage: 1V to 1000V; AC RMS Voltage 10V to 750V; DC/AC current: 10mA to 10A; Resistance: 1KΩ to 40MΩ; Resolution down to: 0.1mV, 0.001mA, 0.1Ω.) It features a continuity beeper, diode test, an Auto Min-Max mode, a relative mode and a probe hold mode. Comes complete with manual, test leads, battery(9V), protective holster with tilt stand and adjustable strap.

SPECIAL
$109.00
Reg.139.00
Model XE380912

$129.00
Reg.159.00
Model X E38091F



DCA/ACA CLAMP METER

Functions as 3 1/2 Digit DMM

Transformer jaws measure up to 400A AC/DC and a peak-hold function provides recall of AC or DC current surges. As a DMM it measures AC voltage, DC voltage, AC/DC current and resistance. The meter has the following ranges:ACV: 750V; DCV: 200mV,200V; DCA/ACA; 200A,400A; Resistance; 2000 ohms; Resolution down to 0.1mV, 0.1A and 1ohm. Comes complete with test leads , battery, carrying case and 1-year warranty. Model RE38091F also has a built-in temperature function, 0-1400°F.

SPECIAL
$59.95
Reg. $80.00
Model XEIM5 Tool Case

SPECIAL
$299.00
Regular $365.00
X22-IM5 117 Pc. Tool Kit



THE PROFESSIONAL'S TOOL CASE

- Case top has built-in document holder
- Case bottom is partitioned into 3 areas
- Two removable pallets hold over 60 tools

A handsome black case to organize and transport your valuable tools and instruments. This is the same quality case used by thousands of professional field engineers. Case is made of high impact polypropylene, and has snap-action key locks and a padded handle.
Size: 17 1/2" x 12 1/2" x 5".

117-PC. PROFESSIONAL FIELD SERVICE KIT

The complete kit comes with the tool case described above and a complete selection of quality, brand-name tools including Diamond, Xcelite and Weller. The kit includes screwdrivers, pliers, tweezers, cutters, wrenches, alignment tools, hex driver blades and a crimping tool, wire stripper, soldering iron & supplies, socket set, penlight, inspection mirror, hammer and more.

Lifetime Guarantee: Any tool that fails under normal use will be replaced free of charge.

SPECIAL
$139.00
Model XC380660

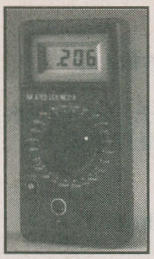


WATT METER + MULTIMETER

You can monitor and evaluate single phase transformers and electrical equipment with true power measurements up to 6000 watts with an accuracy of 1% and a resolution of 1 watt. Multimeter functions include AC voltage(750V), AC current (10A), DC voltage (1000V) and DC Current (10A). Comes complete with manual, test leads, stand and 1-year warranty.

$169.95
Model XAR460D

$249.95
Model XAR470D

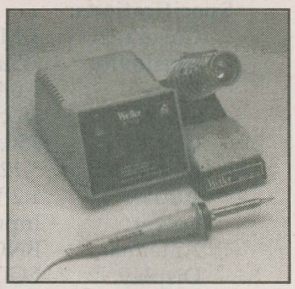


LCR METER

3-1/2 digit LCR meter measures capacitance, resistance and inductance with basic accuracies of 1%(C), 1%(R) and 2% (L). Features dissipation factor measurement which indicates leakage in a capacitor and Q in an inductor. Comes complete with operation manual, test clips, battery(9V) and 1-year warranty.

Features	Model ZAR460D	Model ZAR470D
Capacitance Range	200pF to 200μF	200pF to 20mF
Resistance Range	200Ω to 20MΩ	2Ω to 20MΩ
Inductance Range	200mH to 2H	200mH to 200H
Resolution down to:	0.1pF 0.1μH 100mΩ	0.1pF 0.1μH 1mΩ
Drop-Proof Case	No	Yes

SPECIAL
$99.00
Reg. 128.65
Model XWTCPS



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Widely used in industry. It maintains a constant tip temperature of 700°F. Grounded tip protects components from voltage spikes. Comes with power unit, iron, stand, sponge and 700°F tip.

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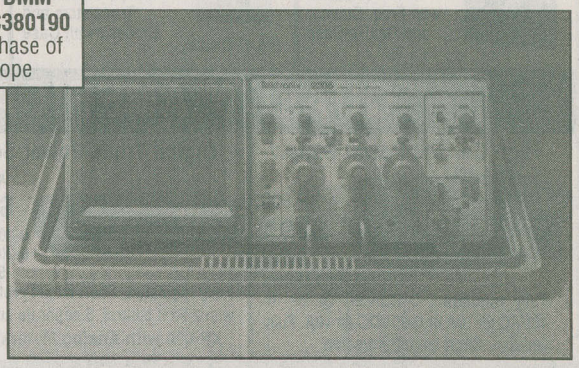
Tektronix

20MHZ TWO CHANNEL SCOPE

$695.00

Model X2205 **1 Year Warranty**

FREE DMM
Model ZC380190
with purchase of
X2205 Scope



Engineered for ease of use with enhanced performance. Features include: 5mV/div vertical sensitivity, 10ns/div horizontal display, and flexible triggering system. Peak-to-peak Auto makes triggering virtually hands free. Also featured are: Front panel access to the z-axis input; risetime of 17.5ns; single timebase with .05µs-.5s range; single sweep, normal, auto, TV field and line trigger modes; DC trigger coupling and Ch1, 2, ext. line and vertical trigger source. Comes complete with manual and two 1X test leads.

SPECIAL

Model X1610 $199.00
Model X1611 $275.00
Model X1630 $299.00



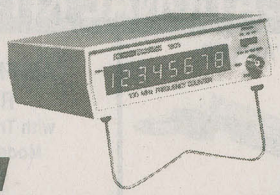
B&K PRECISION

SINGLE-OUTPUT POWER SUPPLY

- **0 to 50VDC up to 3A**
- **1-year warranty**

These fully regulated power supplies feature isolated output, overload protection and two analog monitors. ≤0.01% regulation (line 110V); ≤0.01% load and ≤1mV ripple.
Model X1610 has an output of 0-30VDC@1A.
Model X1611 has an output of 0-50VDC@2A.
Model X1630 has an output of 0-30VDC @ 3A.

SPECIAL
$199.00
Model X1803

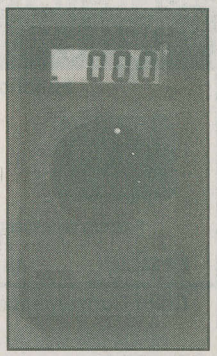


B&K PRECISION

100MHZ FREQUENCY COUNTER

Completely automatic, has full eight-digit LED display, 1Hz resolution with lead-zero blanking, automatic decimal point and overflow indication. Input is through a front panel mounted female BNC connector(1MΩ, 40pF). Additional features include: 30mVrms, 5Hz to 30MHz, 50mVrms, 30MHz to 80MHz, 100mVrms, 80MHz to 100MHz sinewave sensitivity and 200V (peak AC + DC) maximum input. An AC adapter charger is included or the unit can be powered by six user-installed AA batteries. 1-year warranty.

SPECIAL
$29.00
Model XC380190



3-1/2 DIGIT MINI DMM

- **0.8 % accuracy**
- **1-year warranty**

This pocket-sized DMM measures AC/DC voltage, current and resistance, plus features a diode test and signal injection. (It measures DC voltage: 200mV to 1000V; AC voltage: 200V to 750V; DC current 200 µA to 2A; Resistance 200Ω to 2000KΩ; Resolution down to 100 µV, 100nA, 0.1Ω. Signal injector 50Hz square wave, 5V peak to peak.) Comes complete with test leads, battery and instruction manual.

SPECIAL
$249.00
Model X3011



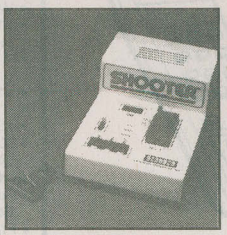
B&K PRECISION

2MHZ FUNCTION GENERATOR WITH DIGITAL DISPLAY

- **0.2Hz to 2.0MHz in 7 ranges**

Features a 4-digit frequency counter display. The basic outputs are sine wave, triangle wave, square wave, TTL pulse and CMOS pulse. The maximum amplitude is 20V p-p (open circuit) and 10V p-p (into 50Ω load). Attenuator is -20dB + 1dB. Output impedance is 50Ω ± 6%. DC offset is continuously variable, from -10V to + 10V(open circuit). Comes complete with power cord, one cable BNC to insulated clips, manual and 1-year warranty.

SPECIAL
$385.00
Model XPP4



LOGICAL

EPROM PROGRAMMER

- **Stand-alone mode**
- **Copies and verifiers**
- **Upload/download in six file formats**

With its 512K-bits of internal RAM, you can program all popular single voltage EPROMs from 2716 through 27512, including CMOS and "A" versions. Can be connected to a dumb terminal, computer, or modem, to perform transfer in six different formats. When operating in the stand-alone mode, you can directly copy and verify EPROMs via the three control switches and LED status indicators. RS-232 port operates at 110, 300, 1200 and 2400 baud. Operates on 110VAC.

SPECIAL
$59.95
Model XT8/1

$189.00
Model XLUV1



LOGICAL

ULTRAVIOLET EPROM ERASERS

You can now erase your UV EPROMs, MICROs and UVE Logic safely and efficiently. Model ZT8/1 has a EPROM capacity of 8, and an erasing time of 20 minutes. Also available is model ZLUV1with an EPROM capacity of 50, and an erase time of 15 minutes.

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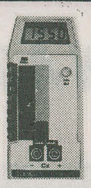
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DIGITAL METERS



True RMS 4 1/2 Digit Multimeter M-7000
$135
.05% DC Accuracy
.1% Resistance
with Freq. Counter
and Deluxe Case



Big 1" Display

Multimeter with Capacitance & Transistor Tester
$55 CM-1500B
Reads Volts, Ohms
Current, Capacitors,
Transistors and
Diodes / with Case

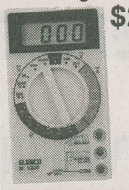
Digital Capacitance Meter CM-1550B
$58.95
9 Ranges
.1pf-20,000ufd
.5% basic accy.
Zero control w/ Case
Big 1" Display



Digital LCR Meter LC-1801
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Measures:
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Caps .1pf-200uf
Res .01-20M



Digital Multimeter $25 M-1000
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XP-800
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Digital
Volt/Amp Meters
Fully regulated, 0-122VAC @ 2A, 0-40VAC @ 10A or 0-30VDC @ 10A. Fully variable, Short circuit protected.

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$269
0-20V @ 1A
0-20V @ 1A
5V @ 5A
Fully regulated, Short circuit protected with 2 limit control, 3 separate supplies
XP-660 with Analog Meters $195

Quad Power Supply XP-580



$59.95 2-20V @ 2A 5V @ 3A
12V @ 1A -5V @ .5A
Fully regulated and short circuit protected

Triple Power Supply XP-620



Assembled $69
Kit $45
2 to 15V @ 1A,
-2 to -15V @ 1A
(or 4 to 30V @ 1A)
and 5V @ 3A
All the desired features for doing experiments. Features short circuit protection, all supplies.

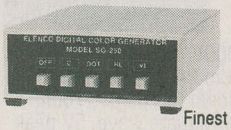
GENERATORS & VIDEO PRODUCTS

Function Generator Blox #9600



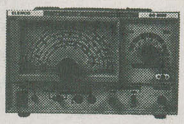
$28.95
Provides sine, triangle, square wave from 1Hz to 1MHz
Kit $26.95 AM or FM capability

Color Convergence Generator



SG-250
$79.95
Kit $59.95
Finest in the industry
10 rock steady patterns
RF & Video output

Wide Band Signal Generators



SG-9000
$129
RF Freq 100K-450MHz AM Modulation of 1KHz Variable RF output
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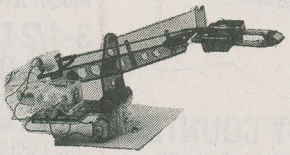
GF-8016 Function Generator with Freq. Counter



$249
Sine, Square, Triangle
Pulse, Ramp, .2 to 2MHz
Freq Counter .1-10MHz
GF-8015 without Freq. Meter $179

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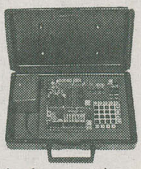
Robotic Arm Kit



Model Y-01 $48.95
Teaches basics of robotics. Arm grabs & releases, lifts & lowers, & pivots from side to side

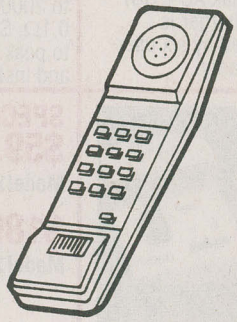
AM/FM Transistor Radio Kit with Training Course Model AM/FM 108
$26.95
14 Transistors ◆ 5 Diodes
Easy to build because schematic is printed right on the PCB
Makes a great school project

Learn to Build and Program Computers with this kit



Includes: All Parts, Assembly and Lesson Manual
Model MM-8000
$129.00
Starting from scratch you build a complete system. Our Micro-Master trainer teaches you to write into RAMs, ROMs and run a 8085 microprocessor, which uses similar machine language as IBM PC.

Telephone Kit



Build this high-tech see-thru telephone. Learn theory on how telephones work and then proudly show off your work with the transparent phone case. Complete with all parts and manual. Deluxe version has flashing neon lamps when phone rings.

(Deluxe) PT-223K $13.95
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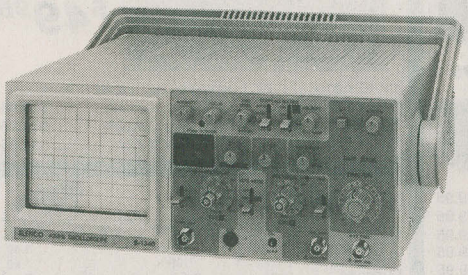
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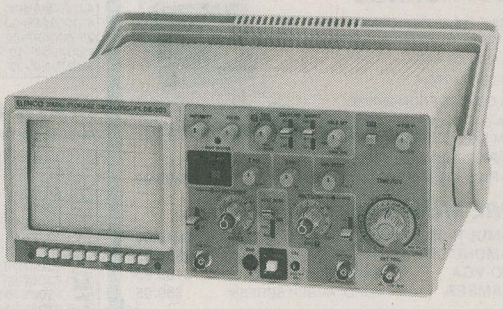


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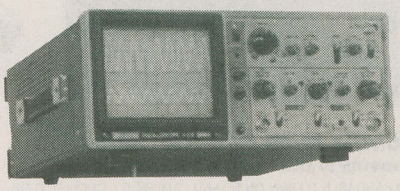
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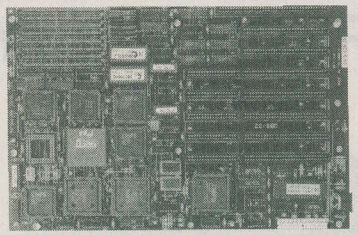
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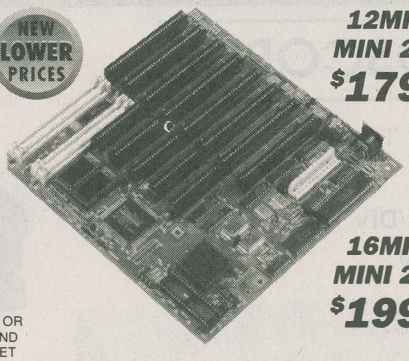
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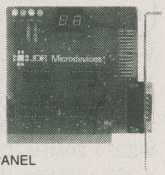
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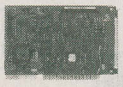
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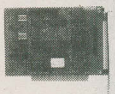
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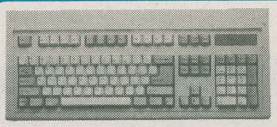
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3-1/2"	ST-138N	32.2MB	SCSI	28MS	$259
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5-1/4"	ST-251-1	42.8MB	MFM	28MS	$249
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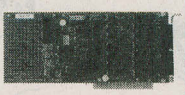
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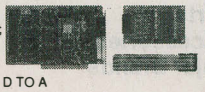
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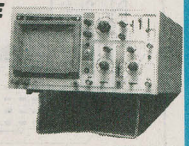
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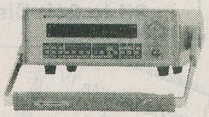
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100MHZ MULTIFUNCTION COUNTER



- RANGE: 10HZ TO 10MHZ DIRECT, 10MHZ TO 100MHZ PRESCALED BY 10
- PERIOD MEASUREMENTS: 10HZ TO 2.5MHZ,±1 COUNT ACCURACY
- TIME BASE:10MHZ
- 8 DIGIT LED DISPLAY W/DECIMAL POINT

DFC-100 $179.95
DFC-1000 1 GHZ VERSION $199.95
DFG-600 SWEEP FUNCTION GENERATOR $189.95
DOS-600 AUDIO OSCILLATOR/COUNTER $189.95

3.5 DIGIT DMM $29.95



- BASIC DC ACCURACY ±0.5%
- DC VOLTAGE: 2V-1000V; AC VOLTAGE: 200V-750V; DC CURRENT: 2MA - 2A
- RESISTANCE: 2KΩ - 2MΩ
- 14 RANGES

DMM-150 $29.95
DMM-200 3.5 DIGIT DMM 22 RANGES $49.95
DMM-300 3.5 DIGIT 19 RANGES W/CAP & TEMP $79.95
DPM-1500 PROBE DMM AUTORANGING $49.95

LOGIC PROBE



LP-100 $17.95
LP-200 PULSER PROBE $19.95

EPROMS



PART#	SIZE	SPEED	Vpp	PINS	PRICE
2716-1	2048x8	350ns	25V	24	4.95
2732A	4096x8	250ns	21V	24	3.95
2764	8192x8	450ns	12.5V	28	3.95
2764-250	8192x8	250ns	12.5V	28	3.95
2764-200	8192x8	200ns	12.5V	28	4.49
27128A-200	16384x8	200ns	12.5V	28	4.95
27256	32768x8	250ns	12.5V	28	4.95
27C256	32768x8	250ns	12.5V	28	5.95
27512	65536x8	250ns	12.5V	28	5.95
27C101-20	131072x8	200ns	12.5V	32	17.95

STATIC RAM



PART#	SIZE	SPEED	PINS	CMOS	LP	PRICE
HM6116-2	2048x8	120ns	24	Y	N	2.95
HM6116LP-4	2048x8	200ns	24	Y	Y	2.95
HM6116LP-3	2048x8	150ns	24	Y	Y	3.25
HM6116LP-2	2048x8	120ns	24	Y	Y	3.95
HM6264LP-15	8192x8	150ns	28	Y	Y	3.95
HM6264LP-12	8192x8	120ns	28	Y	Y	4.95
HM6264LP-10	8192x8	100ns	28	Y	Y	5.95
HM43256LP-15	32768x8	150ns	28	Y	Y	4.95
HM43256LP-12	32768x8	120ns	28	Y	Y	5.95
HM43256LP-10	32768x8	100ns	28	Y	Y	6.95

PALS



PART#	SPEED	PINS	IN	OUT	I/O'S	FUNCTIONS	PRICE
16L8	35ns	20	10	2	6	AND-OR INV	2.95
16R4	35ns	20	8	4	4	AND-OR INV	2.95
16R6	35ns	20	8	6	2	AND-OR INV	2.95
20L8	40ns	24	14	2	6	AND-OR INV	2.95
20R4A	25ns	24	12	4	2	AND-OR INV	3.49
20R6	40ns	24	12	6	2	AND-OR INV	2.95
20R8	40ns	24	12	8	-	AND-OR INV	2.95
20X8	50ns	24	10	8	2	AND-OR-XOR INV	2.95

GALS



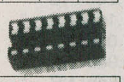
PART#	SPEED	PINS	REPLACES	IN	OUT	PRICE
16V8	35ns	20	10L8 TO 16RP8	8	8	2.49
16V8-15	15ns	20	10L8 TO 16RP8	8	8	2.95
20V8	35ns	24	14L8 TO 16RP8	20	8	3.49
20V8-15	15ns	24	14L8 TO 16RP8	20	8	4.95
22V10	35ns	24	PGM OUTPUTS	22	10	6.95
22V10-15	15ns	24	PGM OUTPUTS	22	10	19.95

D-SUBMINIATURE CONNECTORS



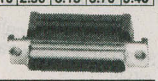
TYPE		ORDER BY	CONTACTS 09	15	25	37	50
SOLDER CUP	MALE	DBxxP	.45	.59	.69	1.35	1.85
	FEMALE	DBxxS	.49	.69	.75	1.39	2.29
R/A PC SOLDER	MALE	DBxxPR	.49	.69	.79	2.27	—
	FEMALE	DBxxSR	.55	.75	.85	2.49	—
W/W TYPE	MALE	DBxxPWW	1.69	2.56	3.89	5.60	—
	FEMALE	DBxxSWW	2.76	4.27	6.84	9.95	—
IDS TYPE	MALE	IDBxxP	1.39	1.99	2.25	4.25	—
	FEMALE	IDBxxS	1.45	2.05	2.35	4.49	—
HOODS	METAL	MHOODxx	1.05	1.15	1.25	—	—
	PLASTIC	HOODxx	.39	.39	.39	.69	.75

IC SOCKETS DIP CONNECTORS



TYPE	ORDER BY	CONTACTS 08	14	16	20	24	28	40
SOLDERTAIL	xx PIN ST	.11	.11	.12	.18	.20	.22	.30
WIREWRAP	xx PIN WW	.59	.69	.69	1.09	1.49	1.69	1.99
ZIF	ZIF-xx	—	6.95	6.95	9.95	10.95	11.95	14.95
TOOLED	AUGATxx	.55	.59	.69	.85	.99	1.09	1.29
TOOLED WW	AUGATxxWW	1.30	1.80	2.10	2.50	3.15	3.70	5.40

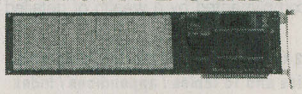
IDC CONNECTORS AND CABLE



DESCRIPTION	ORDER BY	CONTACTS 20	26	34	40	50
SOLDER HEADER	IDHxxS	1.29	1.68	2.20	2.58	3.24
R/A HEADER	IDHxxSR	1.35	1.76	2.31	2.72	3.39
W/W HEADER	IDHxxW	2.98	3.84	4.50	5.28	6.63
R/A W/W HEADER	IDHxxWR	3.28	4.22	4.45	4.80	7.30
HEADER SOCKET	IDSxx	.65	.75	.75	1.19	1.19
RIBBON HEADER	IDMxx	5.50	6.25	7.00	7.50	8.50
IDC EDGE CARD	IDExx	.55	.75	.89	1.29	1.69
RIBBON CABLE	RCxx	.30	.39	.51	.60	.75

ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED. EXAMPLE: A 15-PIN RIGHT ANGLE MALE PC SOLDER PART NUMBER WOULD BE DB15PR.

PROTOTYPE CARDS

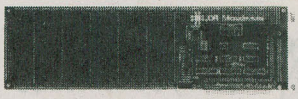


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JDR-PR10 16-BIT WITH I/O DECODING LAYOUT $34.95
EXT-80286 286-COMPATIBLE EXTENDER CARD $39.95
EXT-8088 8088-COMPATIBLE EXTENDER CARD $29.95

SOLDERLESS BREADBOARDS

PART #	SIZE	DIST. STRIPS	TIE PTS	TERM. STRIPS	TIE PTS	BNDG POSTS	PRICE
PDS-100	3.9" X 8.5"	1	100	2	1260	2	12.95
PDS-200	5.1" X 8.5"	4	400	2	1260	3	19.95
PDS-300	6.9" X 9.1"	5	500	3	1890	4	24.95
PDS-400	8.2" X 9.5"	7	700	4	2520	4	34.95

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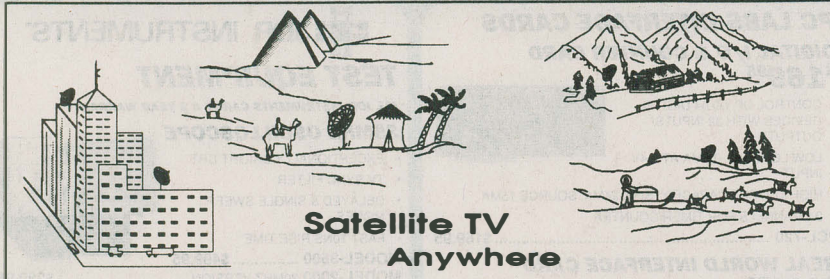
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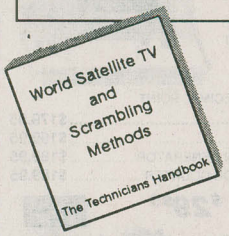
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This thorough text is a must-buy for technicians, satellite professionals and curious do-it-yourselfers. The design, operation and repair of satellite antennas, feeds, LNBs, receivers and modulators are ex-examined in detail. An in-depth study of scrambling methods and broadcast formats including the VideoCipher II, Oak Orion, FilmNet, Sky Channel, EuroCypher, D2 MAC, BSB and Teleclub Payview III. Circuit and block diagrams of all components are presented and clearly examined throughout the handbook. This information is a prelude to the chapters on troubleshooting and setting up a test bench. This expert guidance on testing, servicing and tuning is complimented by a wealth of detailed illustrations.

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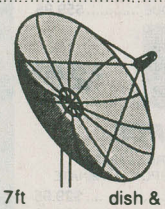


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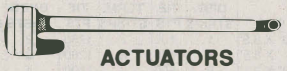
VHS or Beta....S&H $3 (U.S) $33.95



ORBITRON Mesh Dishes

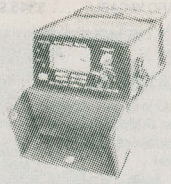
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7ft	dish & polar tracking mount		$239
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10ft	"	"	349
10ft	H D.	"	439
12ft	"	"	699



ACTUATORS

18"	Superjack II	S&H	$14	$89
24"	Superjack XL ball	"	15	139
24"	Venture acme	"	15	129
51"	JGS acme	"	22	219



TUNE YOUR DISH TO ITS MAXIMUM!

"With The Pico" Signal Meter

A must for the serious dealer or satellite system owner. Saves time, frustration and money. Use when installing a new system, moving your dish, re-alignment of a dish that has been moved by wind, frost heaves etc., gets you right on the satellite belt for the best possible pictures!

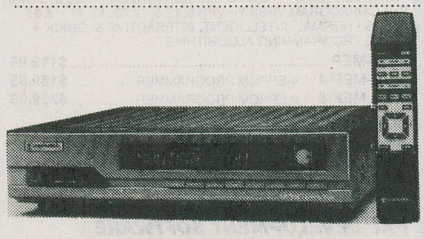
Pico signal meter S&H $6 $89.95



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45°	LNB	C-band 4GHz		S&H $6	$99
40°	LNB	"	"	"	109
30°	LNB	"	"	"	149
<30°	LNB	(25°-29°)		"	199
1.3db.	LNB	Ku 12GHz		S&H $6	$109
1.2db	LNB	"	"	"	119
1.1db	LNB	"	"	"	129
1.0db	LNB	"	"	"	139
0.9db	LNB	"	"	"	199
0.8db	LNB	"	"	"	249
50°	LNA	.(70MHz & block)		S&H $6	$129
45°	LNA	"		"	139
40°	LNA	"		"	149
35°	LNA	"		"	159
30°	LNA	"		"	179



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UNIDEN UST4200	(slave recv.)	$709	
UNIDEN UST4400	(IRD)	$877	$1309
HTS V	(IRD)	$1099	$1539
HTS VIII Plus	(IRD)	$1255	$1698
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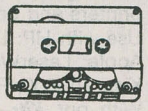
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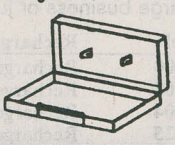
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CASSETTE STORAGE CASE

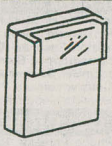


Black, unbreakable plastic audio cassette storage case.
CAT# CBOX 5 for $1.00 • 100 for $15.50

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ATTENTION NINTENDO™ USERS!!!





CAMERICA "Freedom Connection" ™
Turns your wired Nintendo™ control paddle into a remote control unit. Infrared remote like those used on TV's and VCR's eliminates messy wires. Allows players more mobility. Two players can use one remote unit except on games where they play simultaneously. In those games two "Freedom Connections" units are required. A well-known national discount toy chain sells these for more than twice our price. Operates on 4 AAA batteries (not included).
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Set of 4 AAA batteries **CAT# BAT-4AAA $2.40 per set**

TOUCH DIMMER



The "brain" part of the "LITE TOUCH" touch dimmer, when connected to any lamp, will turn it on and off and change the brightness level when any metal part is touched. We don't have the wiring harness that originally connected this to the lamp, but we can provide a simple hook-up diagram and instruction sheet. The solid-state circuitry is contained in a thermoplastic box 1.91" X 3.11" X 0.835".
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OPTO-SENSORS



GE H1381
U-shaped opto with 0.125" gap between emmiter and sensor. 0.75" mounting centers.
CAT# OSU-11 2 for $1.00



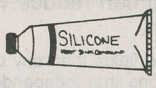
TRW/Optron # OPB5447-2
IR emitter/sensor pair in Rectangular package with 28" color coded leads.
CAT# OSR-4 2 for $1.00

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Diffused T 1-3/4 size (5 mm)



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10 for $1.50 • 100 for $13.00
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FLASHING LED

W/ built in flashing circuit 5 volt operation. T 1-3/4 (5mm)



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LED HOLDER



Two piece holder.
CAT# HLED 10 for 65¢

RECHARGEABLE BATTERIES

Nickel-Cad



AAA SIZE $1.50 each
1.2 volts 180 mAh
CAT# NCB-AAA

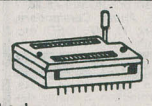
AA SIZE $2.00 each
1.25 volts 500 mAh
CAT# NCB-AA

AA SIZE $2.20 each
WITH SOLDER TABS
CAT# NCB-SAA

C SIZE $4.25 each
1.2 volts 1200 mAh
CAT# NCB-C

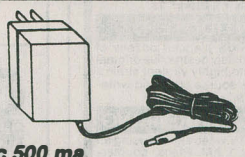
D SIZE $4.50 each
1.2 volts 1200 mAh
CAT# NCB-D

24 PIN ZERO INSERTION FORCE SOCKET



Textool # 224-3344.
Protect 24 pin dip IC's from damage during test, burn-in or programming.
Lever-operated mechanism locks part securely in place and releases it with no damage to component leads.
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12 Vdc 500 ma.
2.1mm D.C. power plug with center negative. White case.
CAT# DCTX-125W $4.50 each
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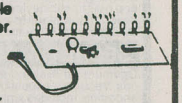
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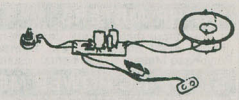
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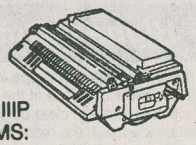
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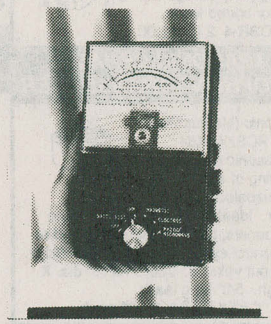
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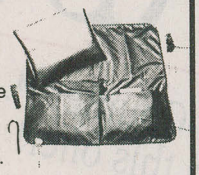
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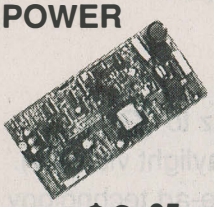
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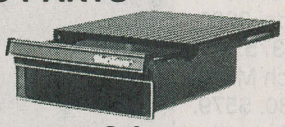
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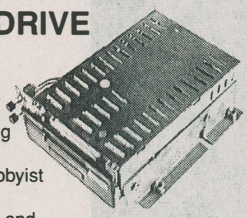


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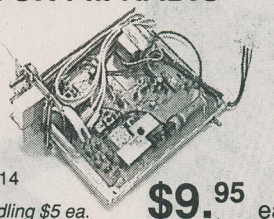
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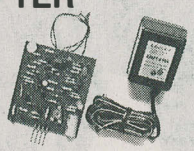
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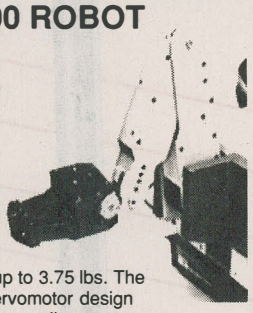


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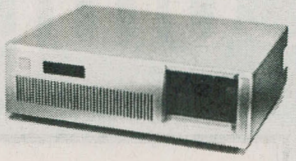
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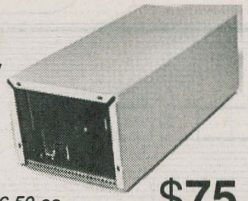


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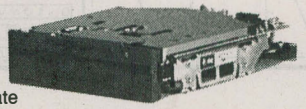


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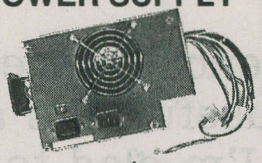


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·Fujitsu M2552A
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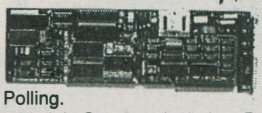
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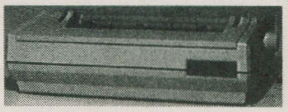


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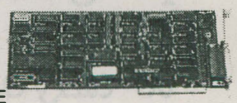
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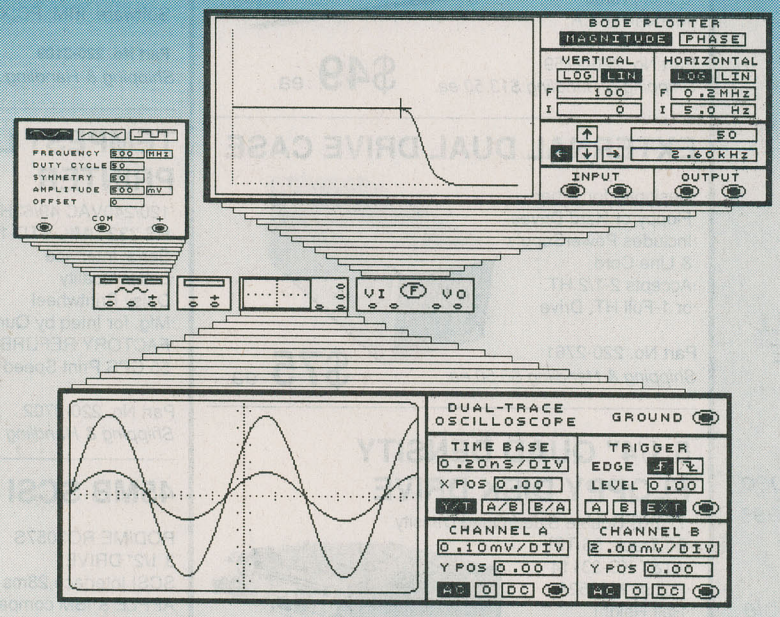
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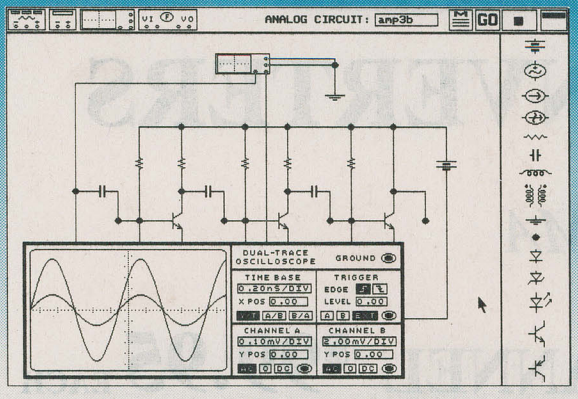
Art Salsberg, Editor-in-Chief, Modern Electronics Magazine

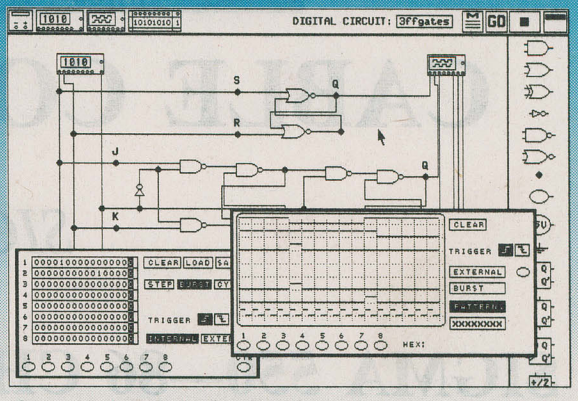
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Complete with simulated instruments.

The Electronics Lab in a Computer!

Feature Summary

- digital and analog modules included
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- multimeter
- spectrum analyzer (Bode plotter)
- word generator
- logic analyzer
- logic conversion—truth table to Boolean formula to logic gates
- complete control over component values
- Ebers-Moll bijunction transistor modelling—all parameters under user control
- Quine-McCluskey logic simplification
- print circuit schematic, parts list, instrument readings, macros
- grid snap
- optional grid display
- optional display of component labels and values
- user-defined models for all components
- global component models referenced by name
- block commands—move, copy, cut
- supports over 150 printers—
- user can define new printers
- pan the workspace
- rotate or mirror parts
- rubberbanding orthogonal autorouting wires
- direct manipulation of components and instruments (click and drag)
- zoom instruments for adjustment and reading
- user defined IC macros for parts bin
- customizable parts bins
- customizable hypertext help system

Three Versions

- **Professional Version:** uses color coding for circuit tracing with an unlimited* number of components; EGA/VGA support.
- **Personal Plus Version:** builds circuits containing an unlimited* number of components.
- **Personal Version:** builds circuits contiaining 20 components or less.

*limited only by the amount of memory available

Requirements

- **Professional:** IBM AT or PS/2 or true compatible with 640 kB RAM; Microsoft-compatible mouse; EGA/VGA graphics; hard disk; MS-DOS 3.0 or later.
- **Personal/Personal Plus:** IBM PC/XT/AT or PS/2 or true compatible with 512 kB RAM; Microsoft-compatible mouse; graphics display; two floppy drives or hard disk; MS-DOS 2.1 or later.

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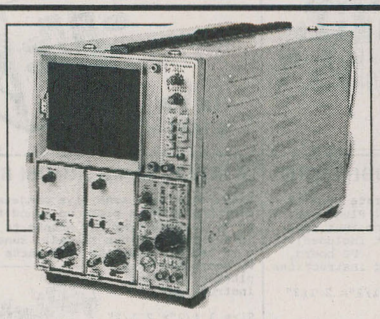
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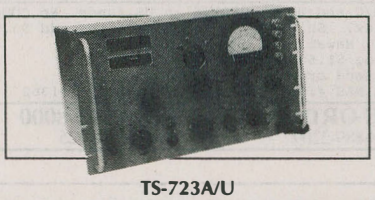
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TEK MODEL 7603N

Oscilloscope: Mil Spec AN/USM-281C, 8 × 10 CM display, 100 mHz response which accepts standard 7000 series Plug-Ins. Vertical Plug-In: 2 ea. 7A15 (AM-6565), frequency BW 75 mHz, maximum sensitivity 5mV/DIV. Horizontal Plug-In: 1 ea. 7B53 (TD-1085), triggering to 100 mHz, minimum, sweep-time 50 NS/DIV, has delayed sweep capacity.

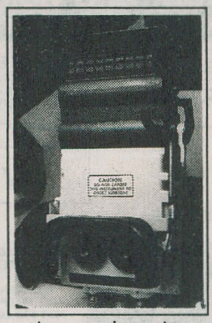
Price: $595.00



TS-723A/U

Spectrum Analyzer: Frequency range 20 Hz to 20 KHz. Fundamental frequency rejection, -80 dB. Inherent distortion <0.1%, sensitivity 0.3% full-scale. Useable to 0.1%. Input impedance 200K ohms 40 pf. Meter frame 0.3 to 300 volts fullscale. VTVM frequency range 10 Hz to 100 kHz + 3% flatness. VTVM input impedance 1M ohm, 3M ohm, 2.4M ohm, 37 pfs dependent on range selected. Noise measurement—full scale 300 microvolts, minimum—75 dBm, frequency—10 Hz to 20 KHz. Power Supply—115V/230V, 50 to 100 Hz, 90 watts.

Price: $150.00



L.R. TANK PERISCOPE

Type M-24. Rugged military construction. Contains two independent infrared image converter tubes plus correction lenses, prisms, and eyepieces. The binocular viewing system is directly connected to a prism-type periscope. The image tubes have dynamic focus provided by a built-in adjustable voltage divider. This unit requires 10 to 15 KV at low current for operation. Unable to supply power supply. (Dimensions: 18" high × 9" wide × 4½" thick. Weight 17 lbs.)

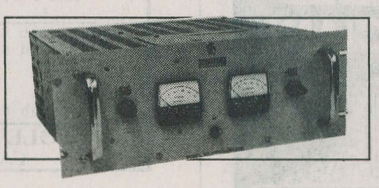
Stock #OP 9001 **Price: $200.00**



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Signal Generator: Freq. 50kHz to 65 mHz in 6 bands ± 1%, freq. call 100kHz and 1 mHz, RF output 0.1 uV to 3.0V at 50 ohms ± 1dB over freq. range, output VWXR—30 DBC leverage 0.10V, modulation 0 to 100% +0.5DB over freq. range. Internal: 400 Hz/1000Hz ± 5%; External: DC to KHz. Power 115/230V, 50 to 1000 Hz, 135 watts. Size: 20¾" (W) × 12½" (H) × 14¾" (L). Wt. 46 lbs.

Price: $250.00

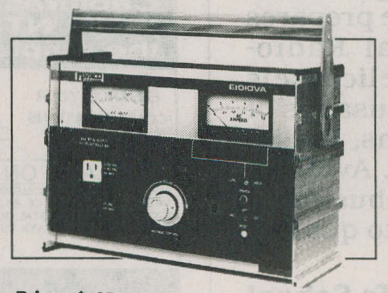


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Solid state output 0-36 VDC, 0-30 amps. Input 115 vac 55 to 60 cps. Current limit adjustable. Dual meters to monitor voltage and current strapped connections in back to allow remote control.

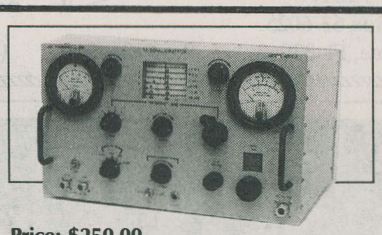
Price: $295.00

A.C. POWER SUPPLY STACO MODEL E1010VA



Price: $165

This unit has been designed and constructed for rigorous industrial, classroom or laboratory applications. These power supplies are brand new. Current list price $750.00. Specifications: Input: 120 VAC 50/60 HZ. Output: 0-120 VAC 10 amps. Includes manual with schematics. Features: Ammeter, voltmeter, convenience outlet, power indicator and circuit breaker. Dimension: 10" × 15" × 6". Weight: 22 lbs.



Price: $250.00

AN/USM 44C

Signal Generator: General purpose, solid state, high frequency generator which provides radio frequency (rf) signals used to test, evaluate and align radio receivers, rf equipment and amplifier. Direct replacement for HP 608 series. Frequency: 10 MHz to 480 MHz ±0.5% in 6 bands. Modulation: Internal AM: 400 and 1000 Hz +10%, 0 to 95% with 0.5 volt RF output. External AM: 0 to 95%, 0.5 volt output, 1.0 volt RMS input @ 20 to 200 KHz. Pulse Modulation: 40 to 200 MHz, 4 usec, 220 to 480 MHz, 1000 Hz. Spurious: 35 dBc, ≤500 MHz. Output: 0.1 microvolt to 1.0 volt continuous +1 dB over frequency range. Leveled Output: ±1 dB (one adjustment, 10 to 215 MHz, +1 dB, two adjustments, 215 to 480 MHz). Power: 115/230 volts AC, 50 to 400 Hz, 150 watts.



HEWLETT PACKARD 8640B-OPT 323 SOLID STATE SIGNAL GENERATOR

(w/o synchronizer) Frequency range: 450 KHz to 512 MHz, to 1100 Mhz with external frequency doubler option (not supplied). Ten Frequency bands in octave increments from 500 KHz; band 11 for doubler use. Accuracy: 6 digit LED read out. Stability: < 1000 ppm. Output power: −145 dBm to +10 dBm (0.013 V to 2 V) into 50 Ω. Level flatness is < +0.5 dB from 0.5 to 512 MHz. Impedance is 50 Ω, VSWR < 2.0 on 2 V and 1 V range < 1.3 on other ranges >. Spectral Purity: Harmonics at 1 V outpt > 35 dB below fundamental of 0.5 to 128 Mhz; > 30 dB below fundamental of 128 to 512 MHz. Modulation: Internal AM, FM and PM, external AM, FM, and PM. Pulse frequency: 0.05 to 5 KHz. General: Power Requirements: 100, 120, 220, 240 V, 48 hz to 420 hz, 2 amps. Note: OPT 323 built to military specifications. Ruggedized performance for better operation under severe environment. Size: 6" (H) × 19" (W) × 13¾" (D). Wt. 60 lbs. Includes ruggedized case and manual.

Price: $1,250.00

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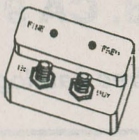
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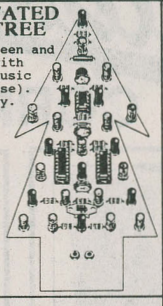
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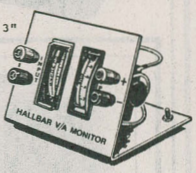


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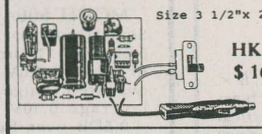


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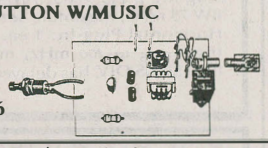


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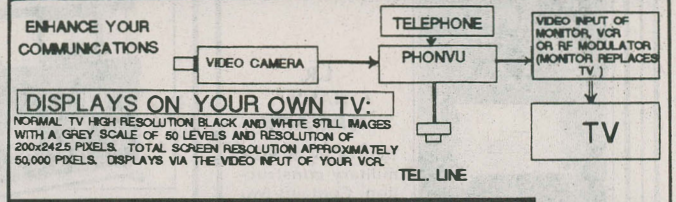
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STARTEK INTERNATIONAL, INC.

- 8 DIGITS
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- ALUMINUM CABINET
- AC • DC • BATTERY
- FULL YEAR WARRANTY

1-1500 MHZ FREQUENCY COUNTERS

FROM **$99.95**

MADE IN USA

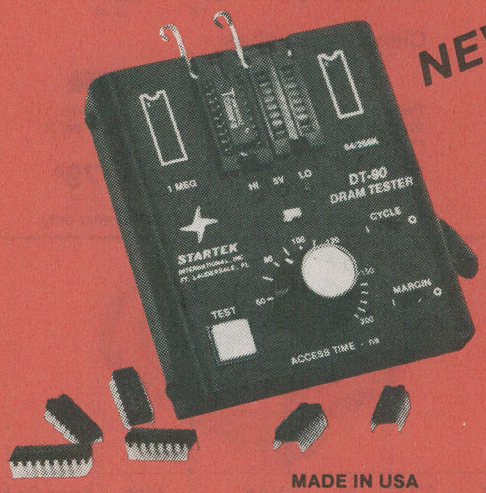


Absolutely the best values in the frequency counter industry. Choose either the ***STARTEK*** Model 1500A or the 1500HS for finding and counting RF frequencies from 1 to 1500 MHZ (1.5 GHZ). The 1500HS is the same size and has the same features as the 1500A but in addition contains Monolithic Microwave Integrated Circuit, Low Noise Amplifiers which provide an **"ULTRA HIGH SENSITIVITY"** signal input. The 1500A can be purchased without the custom NI-CAD batteries and AC adaptor, the 1500HS is priced complete. Both counters can be powered by 9-12 VDC, an AC adaptor or internal NI-CAD batteries. The excellent HF to UHF sensitivity of these instruments makes them ideally suited for use with an antenna to find and display transmit frequencies from handheld, fixed and mobile radios such as: police, ham, surveillance, phone, marine, aircraft, etc. They can be used with the model #DC-10 Probe to measure computer clocks, oscillators, etc.

TYPICAL INPUT SENSITIVITY IN MILLIVOLTS RMS

FREQUENCY	1500 A	1500HS
10-600 MHZ	5-30 mV	<1 mV
150 MHZ	8 mV	.5 mV
800 MHZ	50 mV	3 mV
1.3 GHZ	250 mV	15 mV

#1500A	1-1500 MHZ Frequency Counter Only	**$99.95**
#BP-15	Custom Internal NI-CAD Pack (Installed)	**20.00**
#AC-15	110 VAC to 9 VDC Adaptor/Charger	**9.00**
#1500A/C	Counter Including NI-CAD Pack & AC ADP	**128.95**
#1500HS	HI-SENS Counter Inc. NI-CAD Pack and AC ADP	**169.00**
#TA-90	Telescoping BNC Antenna, General Usage	**12.00**
#DC-10	Probe, 50 OHM, 1X, 3 Ft. Cable	**20.00**



NEW

MADE IN USA

MODEL DT-90 DRAM TESTER

The DT-90 is a new, compact memory IC tester that can READ/WRITE FUNCTION TEST, VOLTAGE TEST and MEASURE THE SPEED of 1 MEG x 1, 256K x 1 and 64K x 1 Dynamic RAMS. LED indicators show 3 Vcc TEST VOLTAGES and a RED/GREEN LED flashes when test is running then indicates PASS or FAIL. A switch is provided to continuously cycle a test if desired. The DT-90 is housed in a rugged aluminum cabinet 3.4" W x 3.8" H x 1" D. Two ZIF TEST SOCKETS are provided for the IC under test. The unit is powered by a 110 VAC to 9 VDC @ 300 mA adaptor which is included. The DT-90 is sold in KIT FORM with complete assembly instructions or FACTORY ASSEMBLED, calibrated and tested.

MODEL DT-90-CK **$89.95** Kit Form

MODEL DT-90 **$119.00** Factory Assembled

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Zener Diode Kit

5 pieces each of the following 1 watt zeners: 5.1V, 5.6V, 6.2V, 6.8V, 7.5V, 8.2V, 9.1V, 10V, 12V, 13V, 15V, 16V, 18V and 24V. This is a comprehensive assortment of popular voltages. Each value is individually packaged and labeled. 70 pieces



#RN-320-190 $12.50 Each

Electrolytic Capacitor Kit

A good assortment of useable electrolytic capacitors. Assorted capacitance and voltage values. 50 pieces total.



#RN-020-910 $2.95 Each

Ceramic Capacitor Kit

A good assortment of values and working voltages. Popular sizes. 100 pieces total.



#RN-020-900 $1.95 Each

300 Piece Capacitor Kit

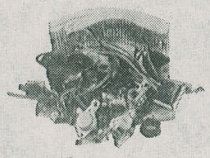
One of our most popular kits. 300 piece assortment consisting of electrolytics, ceramics, mylars, and more. Many different values and voltages. Well worth many times the cost.



#RN-020-920 $4.95 Each

Value Kit

A comprehensive assortment of motors, switches, capacitors, connectors, lamps, transformers and more. A guaranteed wholesale value of at least $25.00.



#RN-320-145 $4.95 Each

Heat Shrink Tubing Kit

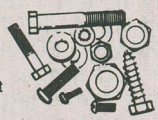
Kit contains 4 ft. each of the following sizes: 1/16", 1/8", 1/4", 1/2" and 3/4" sizes before heating. Assorted colors. Shrinks to 50% of original size.



#RN-320-170 $6.95 Each

3 Lb. Hardware Assortment

A good assortment of small wood, sheet metal and machine screws, machine bolts, nuts, washers, and other hardware. Hundreds of fasteners in different styles, sizes and finishes.



#RN-081-005 $3.95 Each

Matching Transformer

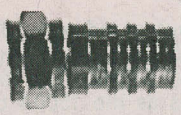
Adapts 75 ohm coax to 300 ohm twin lead (or visa-versa) at antenna or television. 5-90 MHz UHF/VHF. 3 capacitor PC board type.



#RN-180-010 49¢ (1-49) 35¢ (50-up)

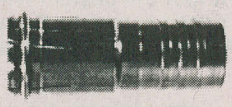
F-59 Connector

Popular connector for cable TV systems. Full ferrule for hex crimp. Securely holds RG-59 cable.



#RN-090-355 22¢ (1-49) 16¢ (50-up)

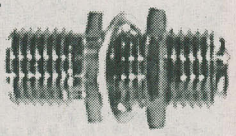
Push-On "F" Adaptor



#RN-090-357 50¢ (1-49) 38¢ (50-up)

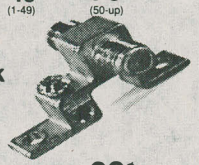
F-81 Connector

(With nut and washer)



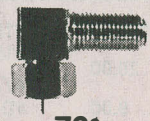
#RN-090-360 40¢ (1-49) 30¢ (50-up)

"F" Type Grounding Block



#RN-090-338 50¢ (1-49) 38¢ (50-up)

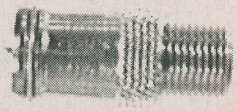
"F" Right Angle



#RN-090-337 90¢ (1-49) 70¢ (50-up)

Deluxe Push-On "F"

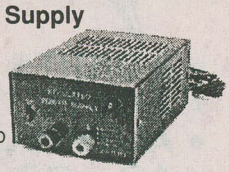
(Full attached ferrule)



#RN-090-356 60¢ (1-49) 48¢ (50-up)

3.5 Amp DC Power Supply

A quality, compact 12 VDC power supply. Perfect for testing car stereos, CB equipment, radar detectors and other 12 VDC items. Regulated 13.8 VDC, 3.5 amp continuous, 6 amp surge. LED power indicator. Binding post outputs. Net weight: 4 lbs.



#RN-120-500 List $79.50 **$23.80** Your Cost

Quality 30 Watt Iron



Economical 30 watt iron with replaceable tip. Blue plastic handle. 120VAC. A quality iron at a reasonable price. Display packaged.

#RN-370-010 $4.90 (1-9) **$4.70** (10-up)

Soldering Stand

Convenient weighted soldering iron stand with cleaning sponge. Display boxed.



#RN-370-020 $4.95 (1-9) **$4.50** (10-up)

Mini Diagonal Plier

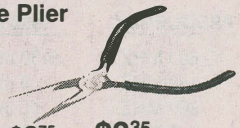
4-1/2" side cutters. Drop forged steel. Dipped plastic, insulated handles.



#RN-360-010 $4.25 (1-9) **$3.80** (10-up)

4-1/2" Long Nose Plier

Quality drop forged steel. 4-1/2 inch overall length. Insulated, rubber dipped handles.



#RN-360-030 $3.75 (1-9) **$3.35** (10-up)

Alligator Clip Set

10 piece set contains two of each: Black, red, white, green, and yellow. 24 gauge, 12" length.



#RN-360-150 $3.25 (1-9) **$2.75** (10-up)

Cleaning Brushes



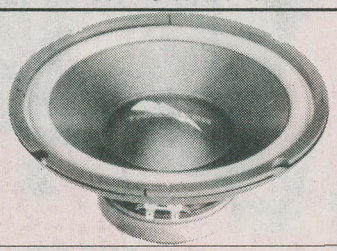
Perfect for cleaning PC boards and other electronic assemblies. 8" overall length. Available with brass or nylon bristles.

#RN-360-400 (Nylon) 95¢ (1-9) 79¢ (10-up)
#RN-360-405 (Brass)

Quantity pricing applies per part number only.

Thruster Woofers

Designed to a take a beating! Specially manufactured with the automobile environment in mind. Humidity resistant polymerized paper cones. Gives them the sound quality of paper and the durability of polypropylene. Heavy duty oversized magnets. Two color printed polymerized dust caps. Red foam anti-fungal surrounds, and structurally superior stamped frame baskets.



Order#	Size	Magnet	V.C.	Z	Freq. Resp.	Power Cap.	SPL 1W/1M	QTS	fs	VAS	List	Your Cost
#293-040	8"	25 oz.	1.5"	4	35-4KHz	150W Max	95 dB	.14	39	1.94	$59.95	**$24.95**
#293-090	10"	30 oz.	2"	4	30-2KHz	175W Max	9623 dB	.12	32	3.78	69.95	**29.95**
#293-125	12"	40 oz.	2"	4	25-2KHz	200W Max	96.1 dB	.16	28	7.38	85.95	**39.95**
#293-150	15"	50 oz.	2"	4	23-2KHZ	250W Max	97.85 dB	.20	25	19.04	99.95	**59.95**

CIRCLE 25 ON FREE INFORMATION CARD

Car Stereo Patch Cables



Special extra long patch cable for connecting low level car stereo output (RCA) directly to a power amplifier. 17 foot length with ground strap to cut down on interference. Gold plated connectors.

#RN-240-140 $4.25 (1-9) $3.95 (10-up)

12" Subwoofer Box



The perfect high volume cabinet for dual voice coil subwoofers. Cabinet volume: 2 cu. ft. with dual ports. This cabinet really performs (and it fits in most autos). It even works well behind the back seat, in the trunk of your car. Box comes with a pre-cut11" hole for a woofer and port holes. Charcoal carpet covered with carry handles and input terminals. Dimensions: 13" (H) x 13" (D) x 30" (W). Net weight: 29 lbs.

#RN-260-495 $59.90 Each

12" Pioneer Subwoofer



12" super duty, dual voice coil subwoofer. 30 oz. magnet, 2" voice coil. 100 watts RMS, 145 watts max power handling capability. 25 Hz resonant frequency. 6 ohm impedance (4 and 8 ohm compatible). Sensitivity: 89 dB 1W/1M. Response: 25-700 Hz. QTS= .31, VAS= 10.3 cu ft. Dimensions: A= 12", B= 4-3/4", C= 3-3/4", D= 1-1/2". Hole: 11-1/4". Net weight: 6 lbs. Pioneer #A30GU30-55D.

#RN-290-145 $39.80 (1-3) $36.80 (4-up)

Subwoofer Crossover Network



Super duty, 200 watt RMS power handling capability. Designed specially for dual voice coil subwoofer systems. 12 dB per octave roll-off at 150 Hz into 8 ohms. Crossover also features a set of outputs for use with your existing speaker system. Network is totally passive, requiring no power source of its own.

#RN-260-220 $28.80 (1-5) $24.40 (6-up)

Subwoofer Input/Output Terminal



This recessed terminal panel has inputs for right and left channels as well as outputs for right and left channels to route to your satellite speakers. Greatly simplifies subwoofer hook-up. Outside dimensions: 3-7/8" x 5-3/8".

#RN-260-308 $3.95 (1-9) $3.50 (10-up)

12 Gauge Neon Wire



The competition in today's auto sound contests is so fierce that good sound alone is not enough to win. More and more installers are striving to make their installation more pleasing to the eye. Parts Express now stocks 12 gauge speaker wire in vibrant neon colors. This wire is the same high quality, made in the U.S. wire you have used before, but now it has flashy, neon colored insulating jackets. Available in neon pink, neon green, and neon orange. Sold by the foot.

#RN-100-162 (Neon pink)
#RN-100-166 (Neon orange) 49¢ /Ft.
#RN-100-170 (Neon green)

4 Ga. DC Power Cable



Large gauge cable for running power and ground to amplifiers in car stereo installations. Sold by the foot.

#RN-100-194 (Red 4 ga.) $1.20 /Ft.
#RN-100-196 (Black 4 ga.)

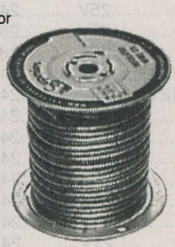
8 Ga. DC Power Cable



Large gauge cable for running power and ground to amplifiers in car stereo installations. Sold by the foot.

#RN-100-174 (Black)
#RN-100-178 (Red)
#RN-100-182 (Neon Pink) 49¢ /Ft.
#RN-100-186 (Neon Orange)
#RN-100-190 (Neon Green)

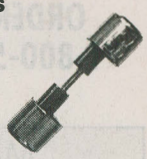
High Power Speaker Cable



Extra large gauge speaker wire for use with very high power stereo systems and for use in extremely long cable runs. Rope lay construction consists of over 250 strands of 36 ga. wire. 21 picofarads per foot capacitance for use with all amplifiers. Extra thick, clear PVC insulation. Polarity is indicated by a black stripe on one conductor. Available by the foot or in 50 and 100 foot spools. **Please order in multiplies of 5 feet.**

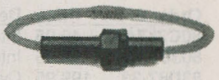
#RN-100-151 (per foot)
#RN-100-150 (50 ft.) 39¢ /Ft.
#RN-100-155 (100 ft.)

AGU High Current Fuses



Part #	Amp	Price (1-9)	Price (10-up)
#RN-070-910	25A	1.40	1.26
#RN-070-915	30A	1.40	1.26
#RN-070-920	40A	1.40	1.26
#RN-070-925	50A	1.40	1.26
#RN-070-930	60A	1.40	1.26

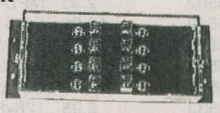
8 Ga. In-Line Fuse Holder



Super heavy duty fuse holder for high current car stereo installations. Screw together Bakelite fuse holder with 8 ga. wire. For use with AGU type fuses or regular AGC fuses when spring spacer is used.

#RN-070-800 $3.20 (1-9) $2.75 (10-up)

4-Way Fuse Block



Fuse block with 4 sets of gold plated fuse clips for use with fuses. Four LEDs indicate when a fuse is good by glowing red. A bridge bar is included for common connection of the input side. Clear plastic cover allows for visual inspection of fuse status. Uses heavy duty fuses.

#RN-070-810 $23.50 (1-5) $21.90 (6-up)

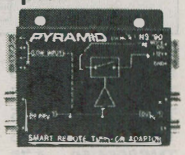
4 Ga.-8 Ga. Distribution Block



Solid brass block with connections for 1-4 ga. wire input from battery and 4-8 ga. wire outputs for power to the amplifiers. Recessed set screws hold the wire in place. Brass block is completely insulated with clear plastic to prevent accidental shorting. Rubber plugs are included to seal set screw holes.

#RN-265-800 $12.90 (1-5) $11.50 (6-up)

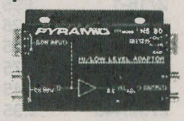
High To Low Level Adaptor



Converts speaker level outputs from your head unit to pre-amp level. Utilizes Op amp circuit design for high power handling and to reduce or eliminate in-line noise problems. Low level output is adjustable from 1 volt to 100 mV. For use with head units rated up to 50 watts per channel.

#RN-265-023 $11.50 (1-3) $10.95 (4-up)

High To Low Level Adaptor With Remote Turn-On



Automatically turns your amp On or Off with your car's head unit. Converts high level to low level pre-amp output. Also features low level inputs. Utilizes operational amplifier circuit design for high power capability and to reduce or eliminate in-line noise problems. For use with head units rated up to 50 watts per channel.

#RN-265-027 $12.50 (1-3) $11.95 (4-up)

Ultimate Woofers

Manufactured in the U.S.A. Ultimate's Polymer Laminate series of woofers are dollar for dollar the best you can buy. Featuring polymer laminate cones to maintain rigidity, extra long throat baskets, extended bump plates, vented pole pieces, double-fold reinforced baskets and more. If you are looking for a woofer that performs flawlessly and looks good too, look no further. Ultimate polymer laminate woofers are here at Parts Express.



Order#	Size	Magnet	V.C.	Z	Freq. Resp.	Power Cap.	SPL 1W/1M	QTS	fs	VAS	(1-3)	(4-up)
#292-510	8"	35 oz.	2"	4	30-3KHz	220W Max	94 dB	.39	40	.89	$46.50	$44.00
#292-515	10"	35 oz.	2"	4	25-3KHz	225W Max	95 dB	.33	29	2.89	56.90	53.50
#292-520	12"	50 oz.	2"	4	20-3KHz	250W Max	96 dB	.31	25	6.27	69.90	65.50
#292-525	15"	50 oz.	2"	4	20-25KHZ	250W Max	97 dB	.39	20	14.35	88.50	84.90

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Local: 513-222-0173
FAX: 513-222-4644

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THE ELECTRONICS SOURCE

FAX DIRECT
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MATH COPROCESSORS

Super Savings Special!!

Order #	Price	Description	Pins
80C287A12	49.95	Intel 12Mhz For 80286 CPU Based Laptops	40
80387-16	99.95	Intel 16Mhz For 80386 CPU Based Computers	PGA68
83D87-33	199.95	Cyrix 33Mhz For 80386 CPU Based Computers	PGA68

COMMODORE COMPUTER CHIPS

Order #	Price	Description	Pins
6502	2.95	MPU with Internal Clock	40
6510	13.95	CPU (906107-01)	40
6520A	3.75	Peripheral Interface Adapter 2Mhz	40
6522	2.95	Versatile Interface Adapter	40
6526A	13.95	Complex Interface Adapter 2Mhz (906108-02)	40
6532	3.95	128x8 RAM, I/O and Timer Array	40
6545-1	3.75	CRT Controller	40
6551A	3.75	Asynchronous Comm. Interface Adapter 2Mhz	28
6567	22.95	Video Interface Chip (906109-01) VIC-II (For C64)	40
6581	11.95	Sound Interface Device (906112-02) 12V	28
8701	6.75	Clock Chip (251527-01)	16
82S100PLA	15.95	For C64 (U17) and C128 (906114-01) No data available	28

EEPROMS (Electrically Erasable)

Order #	Price	Organization	Pins
9346	2.75	1024 Bit Serial, 5V Read/Write	8
2816A35	3.45	2048x8 350ns, 5V Read/Write	24
2817A25	6.75	2048x8 250ns, 5V Read/Write (Pin 1 – Ready/Busy)	28
2864A25	8.95	8192x8 250ns, 5V Read/Write (Pin 1 – N/C)	28
28C64-25	9.95	8192x8 250ns, 5V Read/Write CMOS (Pin 1 – N/C)	28
28C256-25	26.95	32,768x8 250ns, 5V Read/Write CMOS	28

EPROMS (UV Erasable)

Order #	Price	Organization	Speed	Prog. Volt.	Pins
MM5203Q	2.25	256x8	2K ...1000ns	25V	24
TMS2516	4.25	2048x8	16K ...450ns	25V	24
TMS2532	6.95	4096x8	32K ...450ns	25V	24
TMS2564	5.95	8192x8	64K ...450ns	25V	28
TMS2564-50	4.75	8192x8	64K ...500ns	25V	28
TMS2716	5.95	2048x8	16K ...450ns (±5V, +12V)	25V	24
2708	4.75	1024x8	8K ...450ns (±5V, +12V)	25V	24
2716	3.45	2048x8	16K ...450ns	25V	24
2716-1	3.95	2048x8	16K ...350ns	25V	24
27C16	4.25	2048x8	16K ...450ns CMOS	25V	24
2732	3.95	4096x8	32K ...450ns	25V	24
2732A20	4.75	4096x8	32K ...200ns	21V	24
2732A25	3.45	4096x8	32K ...250ns	21V	24
2732A45	2.95	4096x8	32K ...450ns	21V	24
2732B45	4.25	4096x8	32K ...450ns	12.5V	24
27C32	4.75	4096x8	32K ...450ns CMOS	25V	24
2764-20	3.95	8192x8	64K ...200ns	21V	28
2764-25	3.75	8192x8	64K ...250ns	21V	28
2764A15	4.45	8192x8	64K ...150ns	12.5V	28
2764A20	3.95	8192x8	64K ...200ns	12.5V	28
2764A25	3.25	8192x8	64K ...250ns	12.5V	28
2764A45	2.95	8192x8	64K ...450ns	12.5V	28
2764AOTP	2.25	8192x8	64K ...250ns One Time Prog.	12.5V	28
27C64A15	3.95	8192x8	64K ...150ns CMOS	12.5V	28
27128-20	6.75	16,384x8	128K ...200ns	21V	28
27128-25	5.95	16,384x8	128K ...250ns	21V	28
27128A15	5.75	16,384x8	128K ...150ns	12.5V	28
27128A25	3.95	16,384x8	128K ...250ns	12.5V	28
27128AOTP	2.95	16,384x8	128K ...250ns One Time Prog.	12.5V	28
27C128-15	5.95	16,384x8	128K ...150ns CMOS	12.5V	28
27256-15	5.75	32,768x8	256K ...150ns	12.5V	28
27256-25	4.75	32,768x8	256K ...250ns	12.5V	28
27256-30	3.45	32,768x8	256K ...300ns	12.5V	28
27C256-15	5.95	32,768x8	256K ...150ns CMOS	12.5V	28
27C256-25	4.25	32,768x8	256K ...250ns CMOS	12.5V	28
27512-20	6.95	65,536x8	512K ...200ns	12.5V	28
27C512-12	8.95	65,536x8	512K ...120ns CMOS	12.5V	28
27C512-15	6.95	65,536x8	512K ...150ns CMOS	12.5V	28
27C512-25	5.95	65,536x8	512K ...250ns CMOS	12.5V	28
27C010-15	11.95	131,072x8	1MB ...150ns CMOS	12.5V	32
27C020-15	24.95	262,144x8	2MB ...150ns CMOS	12.5V	32

8000

Order #	Price
8031	3.55
80C31	7.25
8035	1.75
8039	1.75
80C39	3.75
8080A	2.75
8085A	2.95
8085A2	3.55
8086	4.45
8088	4.25
8088-1	7.25
8088-2	6.25
8155	2.45
8155-2	3.75
82C11	5.95
8212	2.45
8214	3.85
8216	1.35
8224	2.45
8237A	3.75
8237A5	4.15
8243	1.95
8250	5.75
8251A	2.25
8253	1.95
8253-5	2.25
8254	4.55
8254-2	5.95
8255A5	2.75
8256	10.75
8257	2.25
8259	1.95
8259-5	2.25
8271	42.95
8272	3.75
8274	6.55
8275	18.95
8279-5	3.45
8284A	2.25
8286	2.95
8288	3.75
A80286-10	19.95
N80286-12	21.95
N80L286-8	11.95
R80286-12	26.95
R80286-6	9.95
82C284-8	4.95
82C284-12	19.95
82288-8	4.95
82288-12	19.95
8741	9.95
8742	14.25
8748H	8.95
8749	9.95
8751	24.95
8755	11.95

DYNAMIC RAMS

Order #	Price	Organization	Speed	Pins
4116-12	1.45	16,384x1	120ns	16
4116-20	.85	16,384x1	200ns	16
4816A4	.55	16,384x1 Single +5V	250ns	16
4416-12	2.25	16,384x4	120ns	18
4416-15	1.95	16,384x4	150ns	18
4161-15	4.95	65,536x1 Video RAM	150ns	20
4164-10	1.95	65,536x1	100ns	16
4164-15	1.55	65,536x1	150ns	16
4164-20	1.25	65,536x1	200ns	16
41264-12	6.95	65,536x4 Video RAM	120ns	Skinny Dip 24
41464-80	3.25	65,536x4	80ns	18
41464-12	2.75	65,536x4	120ns	18
41256-80	2.15	262,144x1	80ns	16
41256-10	1.95	262,144x1	100ns	16
41256-12	1.85	262,144x1	120ns	16
41256-15	1.75	262,144x1	150ns	16
51258-80	4.95	262,144x1 Static Column	80ns	16
514256-80	7.25	262,144x4	80ns	20
514256-10	6.95	262,144x4	100ns	20
514258-80	9.95	262,144x4 Static Column	80ns	20
511000-80	7.25	1,048,576x1	80ns	18
511000-10	6.95	1,048,576x1	100ns	18
511000-12	6.55	1,048,576x1	120ns	18
511001-80	8.25	1,048,576x1 Nibble	80ns	18

STATIC RAMS (CACHE MEMORY)

Order #	Price	Organization	Speed	Pins
2101	1.65	256x4	450ns	22
2111	1.75	256x4	450ns	18
2112	2.45	256x4	450ns	16
5101	3.95	256x4 CMOS	450ns	22
2114L20	1.49	1024x4 Low Power	200ns	18
2114-45	1.05	1024x4	450ns	18
2148-3	1.95	1024x4	55ns	18
2149-35	3.75	1024x4	35ns	18
2147-3	3.75	4096x1	55ns	18
20C71-25	6.75	4096x4 CMOS	25ns	Skinny Dip 24
6168-45	3.25	4096x4 CMOS	45ns	20
6116LP1	2.95	2048x8 CMOS Low Power	100ns	24
6116LP3	2.75	2048x8 CMOS Low Power	150ns	24
6116-1	2.75	2048x8 CMOS	100ns	24
6116-3	2.25	2048x8 CMOS	150ns	24
6516-45	4.25	2048x8 CMOS	45ns	Skinny Dip 24
7C128-55	3.95	2048x8 CMOS	55ns	Skinny Dip 24
8128-15	2.15	2048x8	150ns	24
6264LP10	4.95	8192x8 CMOS Low Power	100ns	28
6264LP15	3.95	8192x8 CMOS Low Power	150ns	28
6264-10	4.75	8192x8 CMOS	100ns	28
6264-15	3.75	8192x8 CMOS	150ns	28
8167-55	3.45	16,384x1	55ns	20
6288-25	9.95	16,384x4 CMOS	25ns	Skinny Dip 22
62256LP10	6.75	32,768x8 CMOS Low Power	100ns	28
62256LP15	6.25	32,768x8 CMOS Low Power	150ns	28
628128LP8	34.95	131,072x8 CMOS Low Power	80ns	28
628128LP10	32.95	131,072x8 CMOS Low Power	100ns	28

Z80A, Z80B, Z80-8MHZ, Z8000

Order #	Price	Description	Pins
Z0803008PSD	9.50	Serial Communications Controller 8Mhz	40
Z80A	1.25	CPU (MK3880-4) (780C-1) 4Mhz	40
Z80A-CTC	1.55	Counter Timer Circuit (MK3882-4) 4Mhz	28
Z80A-DART	3.95	Dual Asynchronous Receiver/Transmitter 4Mhz	40
Z80A-PIO	1.85	Parallel I/O Interface Controller (MK3881-4) 4Mhz	40
Z80A-SIO/0	3.95	Serial I/O (TxCB & RxCB Bonded) (MK3884-4) 4Mhz	40
Z80A-SIO/2	3.95	Serial I/O (Lacks SYNCB) (MK3887-4) 4Mhz	40
Z80B	2.45	CPU (MK3880-6) 6Mhz	40
Z84C0008	5.95	CPU 8Mhz (CMOS)	40
Z84C1008	10.95	DMA (Direct Memory Access) 8Mhz (CMOS)	40
Z84C2008	5.95	PIO (Parallel I/O Interface Cont.) 8Mhz (CMOS)	40
Z84C3008	5.95	CTC (Counter Timer Circuit) 8Mhz (CMOS)	28
Z84C4008	8.95	SIO/0 8Mhz (CMOS)	40
Z84C4108	8.95	SIO/1 8Mhz (CMOS)	40
Z84C4208	8.95	SIO/2 8Mhz (CMOS)	40
Z8530	4.55	Serial Communications Controller	40

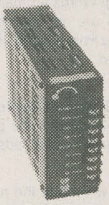
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EASYTECH
THE ELECTRONICS SOURCE

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POWER SUPPLY SPECIAL - LIMITED OFFERING


PSMB15

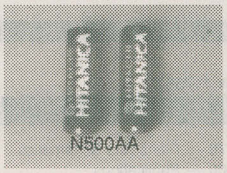
LIMITED TO STOCK ON HAND ONLY - CALL NOW WHILE THEY LAST.

Order #	Price 1-9	Price 10+	Dimensions HxWxD	Input	Output -5V	Output +12V	Output +5V	Weight (lbs.)
PSMB7	14.95	13.95	4.125" x 2.15" x 6.4"	115VAC	1A	1A	7A	1.6
PSMB10	16.95	15.95	4.125" x 2.15" x 6.4"	115VAC	1A	1A	10A	1.65
PSMB15	19.95	18.95	4.875" x 2.0" x 6.9"	115VAC	1A	2A	15A	1.75

The perfect power supply for your test bench, parts box or hamshack. These units are vented for cool operation, heavy duty aluminum construction and finished in matt black.

90 day warranty.

NICAD BATTERIES



N500AA

- Sunrise
- Hitachi
- Varta

Order #	1-9	10+	Voltage	Current	Type
NRAAA	1.95	1.55	1.2V	180mA	AAA
N500AA	1.95	1.55	1.2V	500mA	AA
N1200C	3.45	3.05	1.2V	1.2 Amp	C
N1800C	3.95	3.55	1.2V	1.8 Amp	C
V5022	9.95	8.95	7.2V	100mA	216

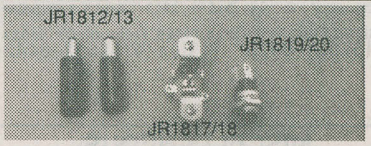
WALL TRANSFORMERS

- UL approved
- Input: 120VAC @ 60Hz
- Conn.: 2.5 mm DC Plug (except WTMT)


WTMT

Order #	1-9	10+	Voltage	Power	Weight
WT9200DC	3.95	3.75	9VDC	200mA	6.1 oz.
WT9500DC	4.15	3.95	9VDC	500mA	8.8 oz.
WT12500DC	4.95	4.75	12VDC	500mA	10.4 oz.
WT9500AC	4.15	3.95	9VAC	500mA	8.8 oz.
WTMT	5.95	5.75	3,4.5,6,7.5, 9 & 12VDC	500mA	9.4 oz.

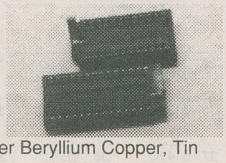
DC POWER CONNECTORS



Order #	1-9	10+	Description	Diam.
JR1811	.50	.40	DC Plug (Walkman Type)	1.3 mm
JR1812	.50	.40	DC Plug (Mini)	2.1 mm
JR1813	.50	.40	DC Plug (Stand.)	2.5 mm
JR1817	.60	.50	DC Chassis Jack (Mini)	2.1 mm
JR1818	.60	.50	DC Chassis Jack (Stand.)	2.5 mm
JR1819	.90	.80	DC Chassis Jack	2.1 mm
JR1820	.90	.80	DC Chassis Jack	2.5 mm

LO-PRO ZIF SOCKETS

ARIES ELECTRONICS, INC.



- CAM: Cast Metal
- Contacts: Spring Temper Beryllium Copper, Tin Plated
- Housing: Glass Filled Polyester, UL94V-O

Order #	Price	Description	Pins
SZ24	5.95	Zero Insertion Force Socket	24
SZ28	6.25	Zero Insertion Force Socket	28
SZ40	6.95	Zero Insertion Force Socket	40

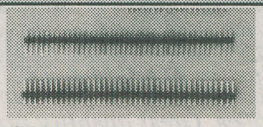
IC TEST CLIPS



- Test most standard DIP packages
- Easier, faster, hands-free testing
- Gold plated pins

Order #	1-9	10+	Description	Contacts
EC16	4.95	4.45	Test Clip	8/14/16
EC20	6.95	6.45	Test Clip	18/20
EC24	7.95	7.45	Test Clip	22/24
EC28	8.95	8.45	Test Clip	28
EC40	11.95	11.45	Test Clip	36/40

SNAPPABLE HEADERS

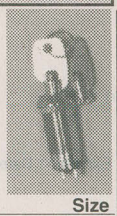


- Contacts: Gold Plated
- Double or Single Row
- 90° Right Angle or Straight

Order #	1-9	10+	Description	Contacts
H401	.89	.79	Header Single, Straight	40
H401R	.99	.89	Header Single, 90°	40
H402	1.49	1.39	Header Double, Straight	80
H402R	1.69	1.59	Header Double, 90°	80

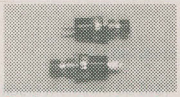
KEY SWITCH

- Key Style: Tubular
- 2 Sizes: Small & Large
- Mounting: 0.78" (19.2 mm)
- Radial 7 Pin Tumbler Mechanism
- Silver Plated Contacts & Terminals
- Brass Housing & Cylinder, Chrome Plated
- Contact Rating: 6A @ 125VAC, 3A @ 250VAC
- Small Unit: Body Length – 0.27" (6 mm) Shorter



Order #	1-9	10+	Size
EG051S	4.25	4.05	Small
EG051L	4.45	4.25	Large

MINI PB SWITCH



- Contact Rating: 1A @ 125VAC
- Mounting Hole: 9/32" (7 mm)

Order #	1-9	10+	Desc.	Color
E1033R	.49	.39	N/O	Red
E1033B	.49	.39	N/O	Black
E1034R	.59	.49	N/C	Red
E1034B	.59	.49	N/C	Black

JUMPER WIRES


JW350

FEATURES
- 22 Awg wire
- Stripped 0.25"
- 14 assorted lengths (25 pieces each length)

Order #	1-9	10+	Description
JW350	9.95	8.95	Jumper Wire Kit
JW350R	7.95	6.95	Refill Wire Pack

22 AWG JUMPER WIRE

JW100RD



- 100 foot spools
- Single core/solid wire

Order #	1-9	10+	Color
JW100BE	4.95	3.95	Blue
JW100BK	4.95	3.95	Black
JW100GR	4.95	3.95	Green
JW100GY	4.95	3.95	Gray
JW100RD	4.95	3.95	Red
JW100YL	4.95	3.95	Yellow
JW100WT	4.95	3.95	White

EASYTECH
THE ELECTRONICS SOURCE

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DECEMBER 1991

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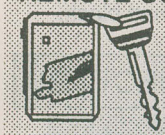
PE MARKET CENTER CLASSIFIEDS

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BUILD OR buy **assembled,** four digit SWR & power meter, with alarm & set points. Plans available. **Free information. Rupp Electronics,** 5403 Westbreeze, Fort Wayne, IN 46804. (219) 432-3049.

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MISCELLANEOUS ELECTRONICS FOR SALE

TUBES $2.49, 1000 types, also surplus components, SASE brings lists. DNF, 6690 7 Mile Road, So. Lyon, MI 48178.

TV NOTCH filters. Brochure $1.00. Micro THinc, Box 63/6025, Margate, FL 33063. (305) 752-9202.

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Orders only call 1-800-452-7090 *Information (213)867-0081*

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No Ca. sales. Not for use in cable co. owned equip. For use as a test aid only.

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PC BOARD and schematic design software for the IBM PC/compatible. Create professional PCB layouts (with autorouting — requires EGA) and electronic schematics (CGA) with these inexpensive shareware programs. Both for $7.00. Suncoast Technologies, PO Box 5835PE, Spring Hill, FL 34606.

PROGRAM THE 8051 microcontroller in Basic with this PC/compatible shareware collection. Disk contains Editor, Basic Compiler, Assembler, Disassembler, Procomm plus 3 surprise programs. Only $7.00 from Suncoast Technologies, PO Box 5835PE, Spring Hill, FL 34606.

VISA CALL NOW! MC

FREE 1991 CATALOG

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COMPUTER PRODUCTS
COMPONENTS

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CABLE TV

TV NOTCH filters. Brochure $1.00. Micro THinc, Box 63/6025, Margate, FL 33063. (305) 752-9202.

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is 40¢ per word. Minimum charge is $6.00 per ad per insertion (15 words). Any words that you want set in bold or caps are 10¢ each extra. Bold caps are 20¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **PE Market Center** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by April 14 will appear in the August, 1991 issue that is on sale June 18. Market Center ads will appear Aug., Oct., Dec. etc. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

AD RATES: 40¢ per word, Minimum $6.00.

Send your ads with payment to:
Popular Electronics Market Center, 500-B Bi-County Blvd. Farmingdale, NY 11735

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160 — Business Opportunities
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300 — Computer Hardware
330 — Computer Software
360 — Education
390 — FAX
420 — Ham Gear For Sale
450 — Ham Gear Wanted
480 — Miscellaneous Electronics For Sale
510 — Miscellaneous Electronics Wanted
540 — Music & Accessories
570 — Plans-Kits-Schematics
600 — Publications
630 — Repairs-Services
660 — Satellite Equipment
690 — Security
710 — Telephone
720 — Test Equipment

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Ad No. 1—Place this ad in Category # _____

1 - $6.00	2 - $6.00	3 - $6.00	4 - $6.00	29 - $11.60	30 - $12.00	31 - $12.40	32 - $12.80
5 - $6.00	6 - $6.00	7 - $6.00	8 - $6.00	33 - $13.20	34 - $13.60	35 - $14.00	36 - $14.40
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13 - $6.00	14 - $6.00	15 - $6.00	16 - $6.40				
17 - $6.80	18 - $7.20	19 - $7.60	20 - $8.00				
21 - $8.40	22 - $8.80	23 - $9.20	24 - $9.60				
25 - $10.00	26 - $10.40	27 - $10.80	28 - $11.20				

Ad No 1—Total words _____ × .40 per word $ _____
All Caps words _____ × .10 per word $ _____
Bold words _____ × .10 per word $ _____
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TOTAL COST OF AD No. 1 $ _____

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[] Check [] MasterCharge [] Visa ($15.00 minimum credit card order)

Card # _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Expiration Date _ _ / _ _

Signature _____

Name _____

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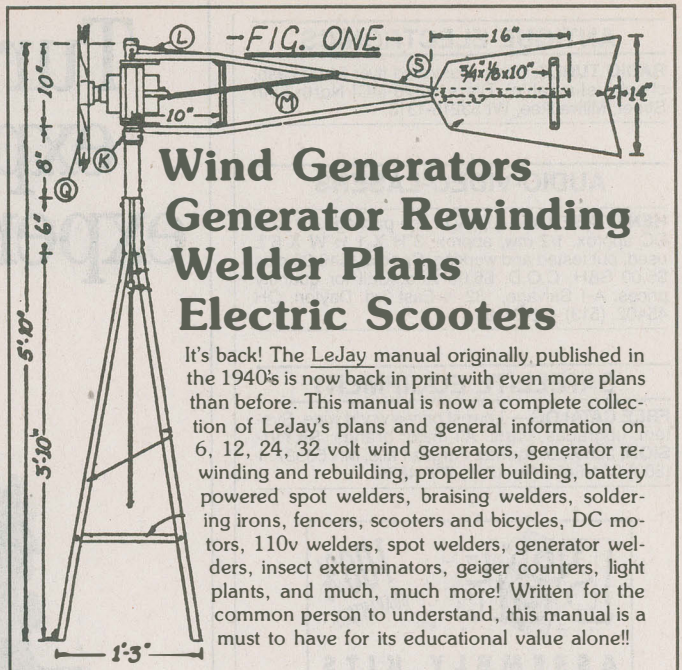
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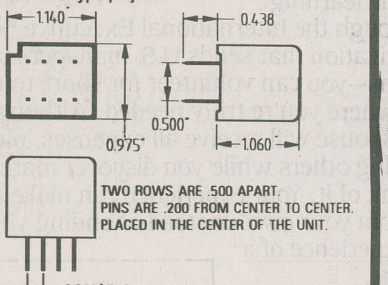
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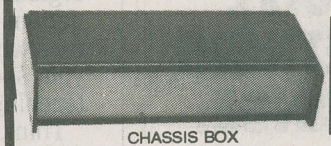
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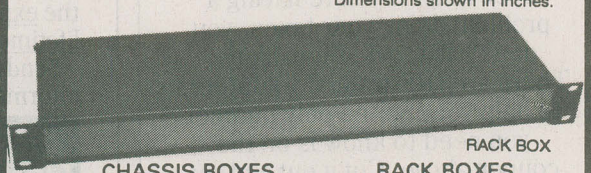
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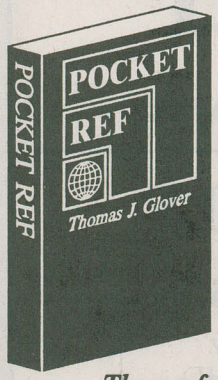
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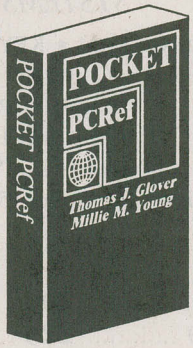
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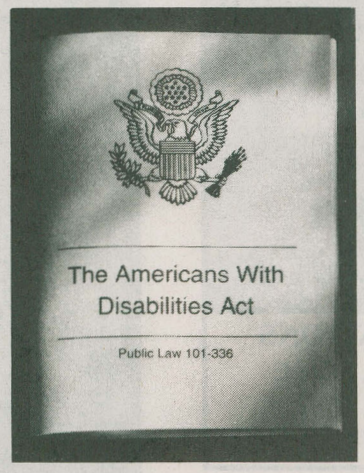
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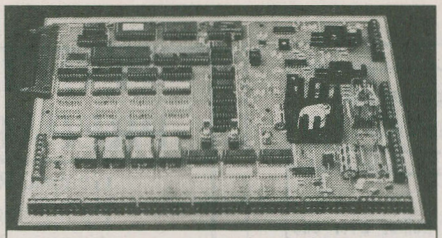
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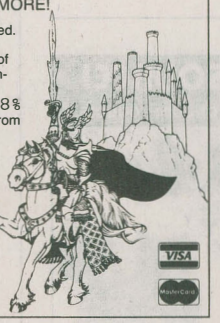
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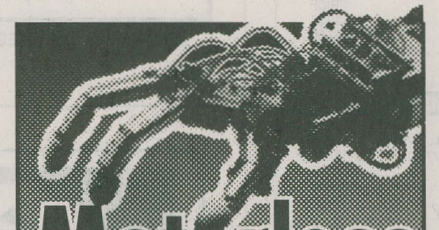
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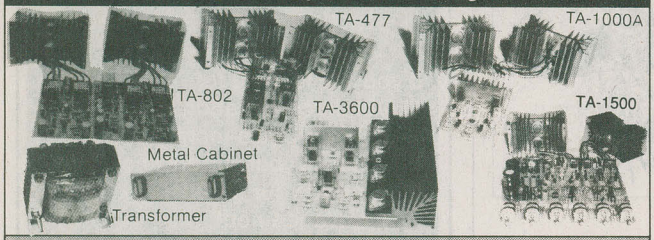


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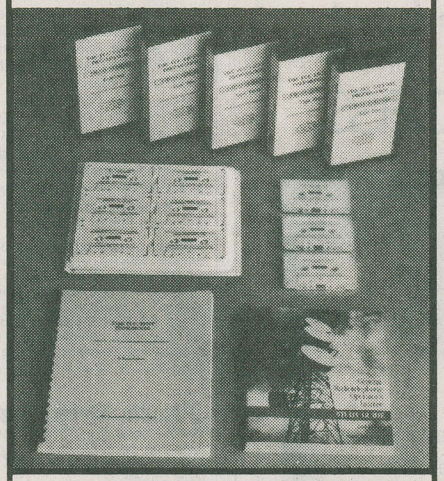
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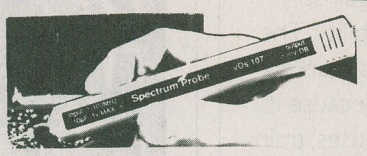
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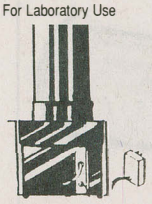
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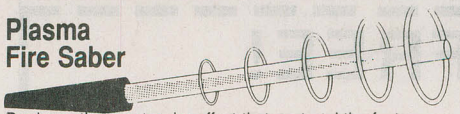
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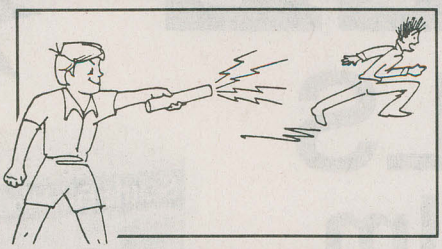
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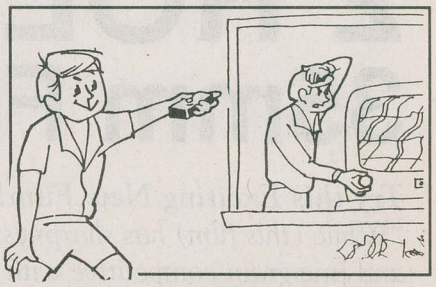
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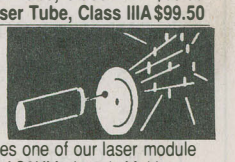
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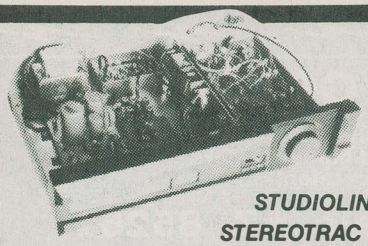
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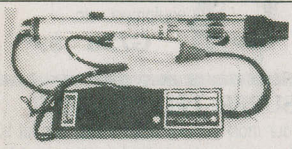
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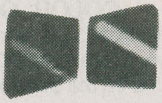
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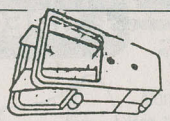
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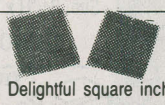
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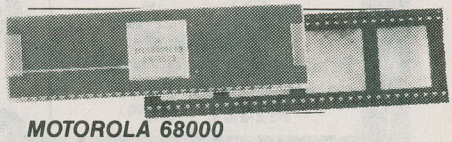
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CIRCLE 37 ON FREE INFORMATION CARD

The Music-On-Hold Box

Endow your telephone with a feature usually reserved for more expensive phones at a fraction of the cost

BY MIKE GIAMPORTONE

Have you ever been involved in a phone conversation when halfway through a discussion, you needed to put someone on hold while you retrieve some important information for the other party? Or while in a telephone conversation, one of the children required your immediate attention? Covering the mouthpiece is not only inadequate and awkward, but it's also rude and does not prevent the other party from hearing what's going on at your end. And even if your phone provides a hold function, it is only humane to give the other person on the line something pleasant to hear, rather than dead silence.

Of course, one might feed local radio programming into the system for the party on hold to listen to, but some of the programming now traversing the airwaves can be more offensive to people than silence. The *Music-On-Hold Box* described in this article is designed for just such occasions. And the circuit, which can be built and installed in one evening (at a cost of less than $11), is easily added to an existing phone system.

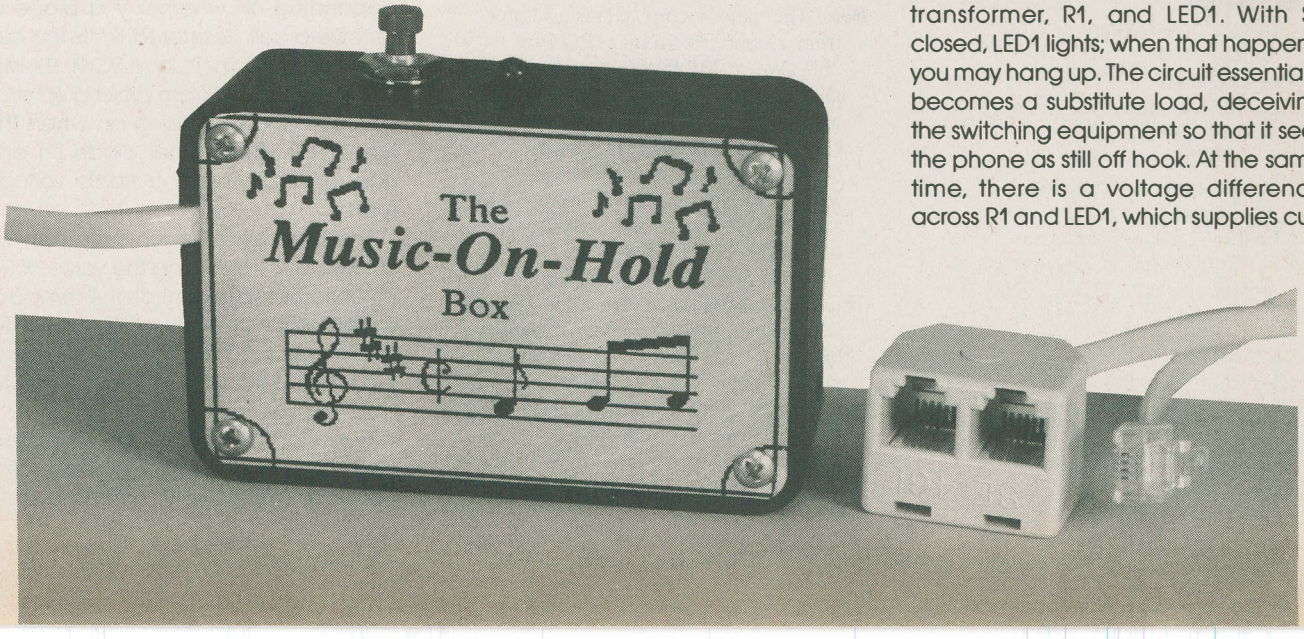
The Music-On-Hold Box is built around an LS3404 melody chip, manufactured by LSI Computer Systems, that is available in 31 versions, each containing a single tune or medley of tunes. The chips require few support components, and allows customizing of the tune/medley being played. Changing the song is as simple as plugging in the IC containing the new tune or medley.

Ease-of-Operation. The circuit is easy to install and operate. Once installed, all you have to do is press a button and hang up the handset to "pipe" music to the other party while he or she awaits your return. And if you have extension telephones connected to the same line, lifting one of the extensions (or the original phone) stops the circuit, allowing you to resume the conversation unimpeded.

The Music-On-Hold Box uses an LED to indicate the status of the call. If desired, the melody, tempo, or volume can be easily changed. In addition, the circuit—which is powered from the phone line so that it requires no external power source—does not load the phone line when it's not in use, so it's virtually undetectable. If desired, an optional transducer can be added to the circuit, so that you too can be entertained by the box's melodic output.

About the Circuit. Figure 1 is the schematic diagram of the Music-On-Hold Box. A normal one-party phone system uses only two wires—known as tip (which is the positive lead) and ring (the negative lead) in telephone tech talk—of the four supplied to each phone station. With the telephone handset on hook, there is approximately 48 volts DC (not to be confused with the 90-volt AC ring signal) across the green (tip) and red (ring) wires. When the telephone handset is taken off hook, a load is placed across the line, causing the DC voltage to drop to approximately 6 volts (depending on the subscriber's loop resistance and telephone).

Pressing S1 applies that DC voltage to the gate of SCR1, causing the SCR to turn on, which applies DC to the bottom of T1's 8-ohm winding and allows current to flow through the rectifier, transformer, R1, and LED1. With S1 closed, LED1 lights; when that happens, you may hang up. The circuit essentially becomes a substitute load, deceiving the switching equipment so that it sees the phone as still off hook. At the same time, there is a voltage difference across R1 and LED1, which supplies cur-



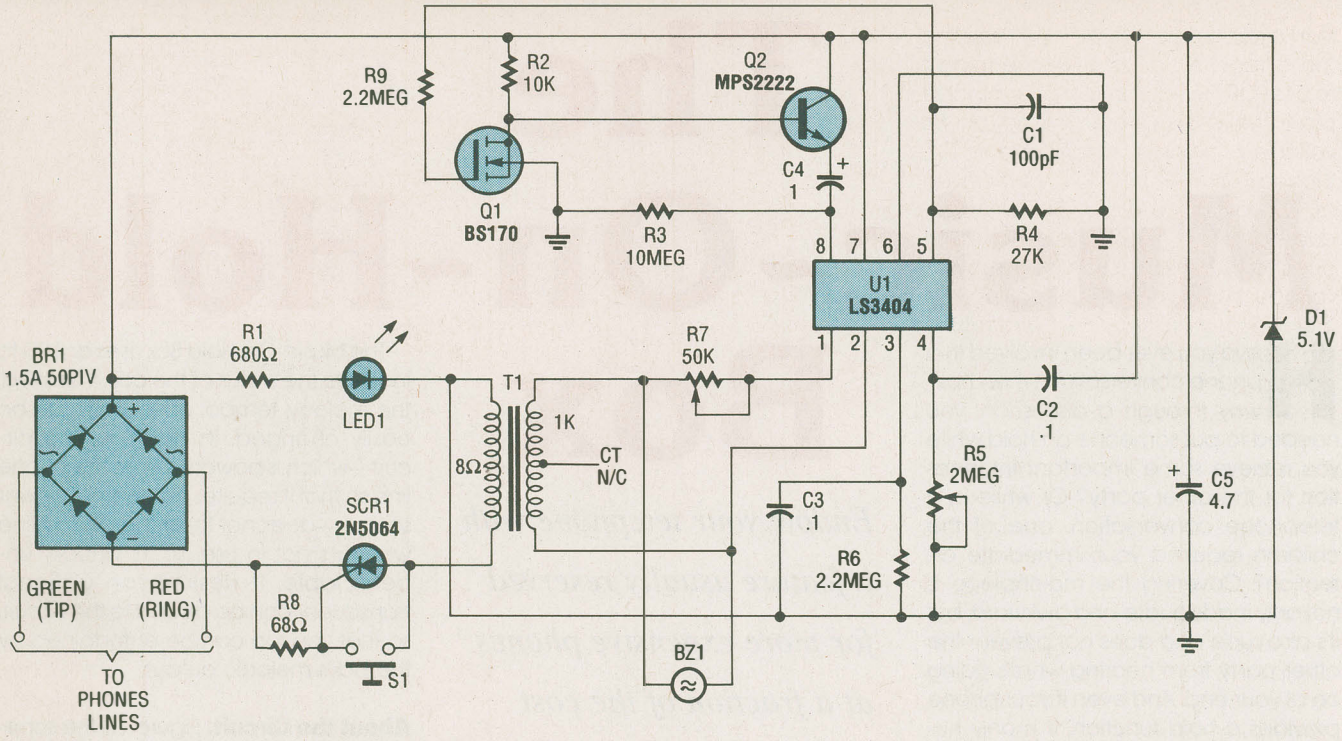


Fig. 1. The Music-On-Hold Box is built around a single-melody chip, which is supported by two transistors, an SCR, and a handful of additional components.

PARTS LIST FOR THE MUSIC-ON-HOLD BOX

SEMICONDUCTORS

U1—LS3404 melody chip, integrated circuit
Q1—BS170 N-channel MOSFET (Motorola)
Q2—MPS2222A or PN2222A general-purpose NPN silicon transistor
BR1—1.5-amp, 50-PIV full-wave bridge rectifier
SCR1—2N5064, 0.8-amp, 200-PIV silicon-controlled rectifier
D1—1N4733A or similar 5.1-PIV, 1-watt Zener diode
LED1—T-1-3/4, 2-volt, 20-mA, red diffused LED

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—680-ohm
R2—10,000-ohm
R3—10-megohm
R4—27,000-ohm
R5—2-megohm PC-mount potentiometer
R6, R9—2,200,000-ohm
R7—50,000-ohm PC-mount potentiometer
R8—68-ohm

CAPACITORS

C1—100-pF, ceramic-disc
C2, C3—0.1-μF, monolithic ceramic-disc
C4—1-μF, 35-WVDC, tantalum
C5—4.7-μF, 50-WVDC, radial-lead electrolytic

ADDITIONAL PARTS AND MATERIALS

T1—1000-ohm CT primary to 8-ohm secondary, audio-ouput transformer
S1—Normally-open, momentary pushbutton switch
BZ1—Piezo transducer, optional (see text)
Printed-circuit materials, enclosure, 8-pin DIP socket, LED holder, modular telephone cable and connectors (see text), wire tie, shrink tubing, wire, solder, hardware, etc.

Note: The melody chip (U1) is available from Thumb Electronics (PO Box 263, Avoca, MI 48006) for $2 each plus $1.50 shipping and handling per order. A 5-tune assortment of melody chips is available for $11, shipping included. Iron-on resist patterns for Music-On-Hold's printed-circuit board are available for $1 each with any order. The BS170 MOSFET (Q1) is available for $2 with any order. Thumb also sells the sheets for making your own iron-on patterns for labeling the cover or PC patterns. For a list of melodies in stock or technical assistance, send a self-addressed stamped envelope to the above address.

rent to the melody chip (U1), and in turn causes it to start playing back across T1. The melody is coupled to the phone line through T1, and transmitted to the receiver on the other end of the line.

When the handset is once again lifted off hook, most of the current flowing through the circuit is diverted to the phone. That drops the current through the SCR below I_H (the SCR's holding current), so the SCR ceases to conduct, thereby turning off U1.

The bridge rectifier (BR1) protects the circuit against polarity reversal when the circuit is connected to the telephone lines. The bridge rectifier is essential for older switching systems where the polarity of tip and ring invert, depending on whether you place or receive a call. Resistor R1 limits the current through LED1, T1, and SCR1. Resistor R8 prevents SCR1 from picking up stray voltages and remaining on when the handset is lifted. Zener diode D1 and capacitor C5, insure a stable voltage for U1.

The duration of each note can be shortened by reducing the value of R6. Potentiometer R5 controls the tempo or speed of the melody, while resistor R4 sets the pitch. Lowering R4's value raises the pitch of the tune. Potentiometer R7 limits the volume.

Transistors Q1 and Q2 (an N-channel MOSFET and a general-purpose NPN transistor, respectively) comprise a re-

start circuit, which resets U1 by inverting the voltage at pin 5 of U1 and feeding it to U1's POR (power-on-reset) terminal at pin 8. While the tune is playing, pin 5's voltage is applied to the gate of Q1, biasing it on. That, in turn, holds the base of Q2 low, preventing it from conducting. When the melody finishes, U1 goes to its standby state by removing voltage from all pins. The gate of Q1 then goes low, turning it off, and returning base bias to Q2, turning it on. At that point, a pulse is applied to POR terminal pin 8, restarting the melody.

Building the Project. The Music-On-Hold Box was assembled on a small printed-circuit board, measuring 1-7/8 by 2-15/16 inches. A full-size template of the printed-circuit artwork for the board is shown in Fig. 2. If you are not accustomed to producing your own circuit boards from a magazine page, a simple solution is offered in the Parts List: namely, iron-on resist patterns—a process by which the etch-resist pattern is simply ironed onto a copper-clad slug (unetched printed-circuit material). Of course, you'll still have to etch your own board, but at least you won't have to worry about lifting or copying the pattern from the page.

After you've etched and drilled your board, and obtained the parts listed in the Parts List, assemble the circuit using Fig. 3 as a guide. It is recommended that U1 be socketed. Aside from preventing possible damage to U1 during soldering, it will permit quick melody-IC changes.

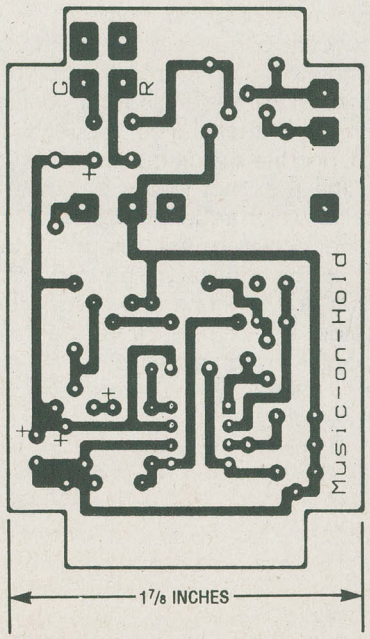


Fig. 2. Here is a full-size template of the printed-circuit artwork for the Music-On-Hold Box's circuit board.

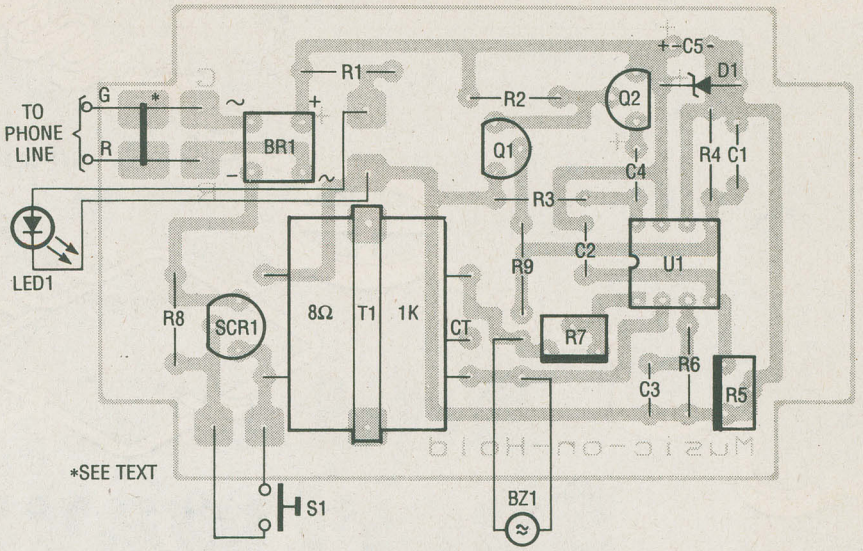


Fig. 3. After you've etched and drilled your board, and obtained the parts listed in the Parts List, assemble the circuit using this diagram as a guide.

Begin assembly by installing an IC socket where U1 is indicated in Fig. 3. Installing the socket first also aids in finding the proper locations for the other parts. Next, solder all resistors in place, and be sure not to get the potentiometers mixed up. Follow that by placing the capacitors in their proper locations, keeping in mind that two of them (C4 and C5) are polarized and must be properly oriented. Tantalum and electrolytic units have labels on them designating their polarity.

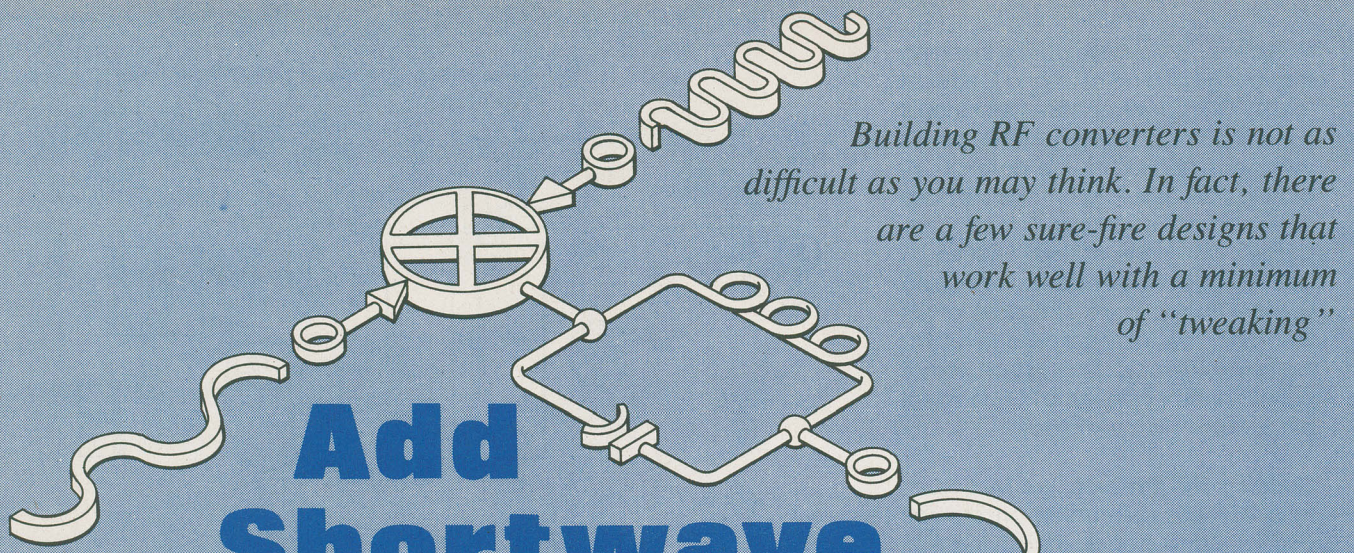
Next install the semiconductor components, and be sure to observe the proper polarity. Transistors Q1 and Q2, and SCR1 come in the TO-92 package style, so they are nearly undistinguishable from each other, save the part number. So consult the part number and pinout information before installing any of those components; it'll save you some aggravation in the long run. If you are not familiar with bridge rectifier markings, the AC inputs on such devices are always marked with a wavy line or indicated by the letters AC, and the plus and minus outputs are marked + and − accordingly. All diodes are also marked; the cathode end is banded.

Now install the transformer. First straighten the transformer leads. Be gentle; When I untangled my first one, I pulled one wire right out of the windings! Cut each lead to about ¾-inch and strip about ¼ inch of insulation from each lead end. Note that although the center tap is not used, a pad is nonetheless provided for that lead. It is recommended that the stranded leads be twisted and lightly tinned before being inserted into their respective circuit-board holes. Tinning helps to prevent bird-caging (fraying) when the leads are inserted. Mount T1 to the board with the center-tapped (3-wire) side toward U1. That insures that the center-tapped primary side is connected to the output of the melody chip. Bend the mounting tabs in toward each other to secure the transformer. Solder all transformer leads in place.

Connect switch S1 to the board through two 4-inch lengths of hook-up wire. Next place a piece of shrink tubing over one lead of the LED, and a second piece over both leads. The first one will keep the LED's leads from shorting. The second will insulate and strengthen both of the leads. Do not heat shrink the tubing at this time. Connect the LED assembly to the board using 3-inch lengths of hookup wire.

Testing. If you haven't done so already, install the melody chip. Set R5 to its mid-position and R7 fully counterclockwise. If you are going to listen to the melody while the person on hold does, connect the optional transducer (BZ1) to the board. If you do not intend to use that option, temporarily connect an 8-ohm speaker in its place. Wire the speaker between either of R7's leads and R5 lead that's furthest from U1. Using a 9-volt transistor-radio battery or DC power supply, apply power to the circuit. The positive side of the supply should go to the pad labeled G and the negative side to the pad labeled R.

(Continued on page 85)



Building RF converters is not as difficult as you may think. In fact, there are a few sure-fire designs that work well with a minimum of "tweaking"

Add Shortwave or VHF Reception to Any Radio

BY JOSEPH J. CARR

A frequency converter, or frequency translator, is a circuit that changes an input frequency to another frequency. Using such circuits, you can receive WWV or shortwave broadcasts on an automobile radio, or you can expand the range of a ham-bands only shortwave receiver to include the very low frequency (VLF) range. Alternatively, you can make an HF shortwave receiver tune to the VHF bands, etc.

Frequency converters are actually a little more common than you might believe. Nearly all serious radio receivers, from the humblest handheld AM-band radio, to the most complex "kilobuck" commercial receiver, contain at least one frequency converter. Such radios are called superheterodyne (or simply "superhet") receivers. The "super" part of that name was probably dreamed up in the advertising departments of early radio manufacturers, but the "heterodyne" part describes its operation.

Radio receivers prior to heterodyne sets were "tuned radio-frequency" (TRF) models. Those radios consisted of two, three or even four separate radio-frequency amplifiers in cascade. Unfortunately, radio circuits (especially in that era) tended to work a lot better at one end of the band than at the other, so performance was very uneven. Also, the techniques that allow a circuit to achieve a high RF gain, a necessity for good sensitivity, also tend to work only at one frequency, or a small band of frequencies. As the radio is tuned away from that "magic" design point, the circuits would become unstable and break into oscillation—complete with screaming, howling, and squawks that became the hallmark of those radios.

By contrast, a superheterodyne receiver converts the RF frequency to an intermediate frequency (IF), where a majority of gain is available. Thus, a high performance radio receiver resulted.

What Is "Heterodyning?" Heterodyning is a process in which two frequencies are combined to produce other frequencies. As a musical metaphor, if you went to a piano and struck a key you would hear a single note with a frequency we'll denote f_1. If you struck another key you would hear another single note that we'll say has a frequency f_2. If you strike both keys simultaneously, the sound produced is a lot richer because it is an audio concoction consisting of the original notes, plus the sum and difference notes. In other words, the signal will contain f_1, f_2, $f_1 + f_2$, and $f_1 - f_2$.

To see how a radio receiver takes advantage of this type of behavior take a look at the block diagram of a frequency converter circuit shown in Fig. 1. There are three elements: a mixer, a local oscillator, and a filter. The mixer has two inputs and one output. Suppose that the RF signal (f_1) is applied to one input, and a local oscillator signal (f_2) is applied to the other input. The frequencies at point "A" in Fig. 1 will be a blend of f_1, f_2, and other frequencies defined by:

$$mf_1 \pm nf_2$$

where m and n are integers (1, 2, 3, etc.). For most practical purposes we will concern ourselves only with the case where n = m = 1, so the output will contain the two original frequencies, f_1 and f_2, the difference frequency ($f_1 - f_2$), and the sum frequency ($f_1 + f_2$).

The filter that follows the mixer will select which frequency is passed to the other circuits as the output frequency (f_{out}). The filter might be a bandpass filter, or it might be a low pass filter (to select the difference frequency), or possibly a high pass filter (to select the sum frequency). In a superheterodyne receiver, f_{out} is the IF.

Common IF's are 10.7 MHz for FM-broadcast radios and VHF/UHF scanners, 455 kHz for most AM radios, and 262.5 kHz for AM car radios. Those radios typically use the difference frequency. Other receivers actually upconvert the RF signal to a higher (sum) frequency. For example, a certain HF shortwave radio upconverts the shortwave band (0.5 to 30 MHz) to a 50-MHz IF.

Let's consider an example of a superhet frequency converter. Suppose we have an AM radio with a 455-kHz IF stage. When the radio is tuned to 780 kHz, the local oscillator will simultaneously be tuned to 780 + 455 kHz, or 1,235 kHz. At the output of the mixer, therefore, the following frequencies are present: 780 kHz, 1,235 kHz, 455 kHz, and 2,015 kHz. The filter, typically a tuned transformer, passes the 455-kHz difference frequency to the rest of the circuitry.

For the sake of clarity, it should be mentioned that in common "radio jargon," the term "converter" is usually reserved for those circuits in which the roles of the mixer and local oscillator are performed by a single circuit. That is typical of most AM radios. A "mixer-oscillator" on the other hand, is a circuit in which the mixer and local oscillator are altogether separate. However the result is exactly the same, so for practical purposes permit me to call both varieties "converters."

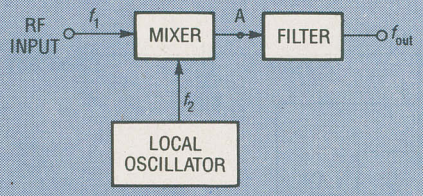


Fig. 1. A frequency converter, which consists of these basic building blocks, can commonly be found in many different types of receivers.

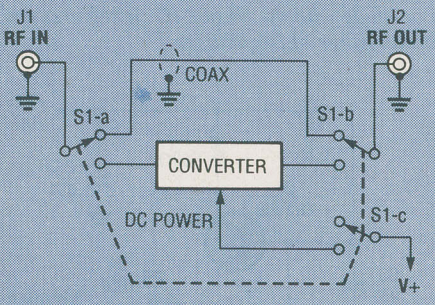


Fig. 2. A converter can be switched in and out of the RF path (between the antenna and receiver) in this fashion.

Frequency-Converter Circuits. An add-on converter can expand the range of a receiver by taking incoming RF and converting it to an IF that falls within the receiver's operating band. Figure 2 shows how such a circuit can be connected to a radio receiver. The converter is switched in and out by a switch (S1) that bypasses the converter when normal receiver operation is required. A short piece of coaxial cable between the switch sections carries the bypass signal when the converter is not being used.

Although this method of connecting converters is universal, there are several approaches to designing converter circuits themselves. We'll take a look at three different circuits, all of which can be used over a wide range of frequencies.

Two of the circuits are based on 40673 MOSFET's. The 40673 can be used from very low frequencies up to VHF frequencies in the neighborhood of 200 MHz. It differs from certain other MOSFET devices because it has gate-protection diodes built in that allow it to withstand electrostatic voltages that would destroy other MOSFET's. This device is readily available from local and mailorder distributors. It is also used a lot in consumer electronics, so it is available in the NTE and ECG component-replacement lines. In fact, to test some of the circuits I used an NTE222 (the same as the ECG222), which is a replacement for the 40673.

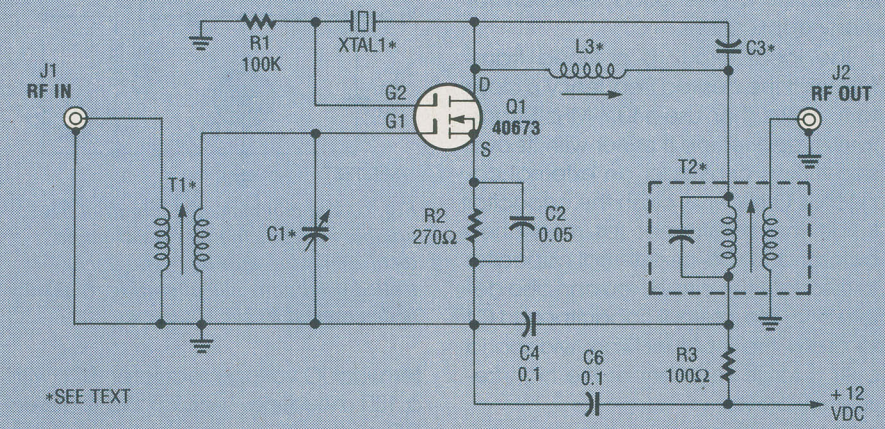


Fig. 3. The mixing of the local-oscillator and tuned RF frequencies occurs in Q1 in this circuit. The signal is then filtered by T2 to yield only the desired output frequency.

Figure 3 shows a single-stage converter circuit based on a 40673 MOSFET. The RF signal is applied to gate 1 (G1) through a tuned transformer and a DC blocking capacitor. The tuned transformer consists of a low-impedance winding of a few turns, and a larger coil (the secondary) that is used to resonate with the tuning capacitor.

The transformer can be made from a toroidal core, a commercial coil form, or a ready-made coil. Components for coils and RF transformers can be bought from several sources. Two that I've used include Radiokit (PO Box 973, Pelham, N.H., 03076; 603-635-2235; catalog $1) and Amidon Associates (12033 Otsego Street, North Hollywood, CA, 91607). Both companies have catalogs, and Amidon will supply design information for making your own coils. Digi-Key Corporation (PO Box 677, Thief River Falls, MN, 56701-0677; 1-800-344-4539; free catalog available) sells coils and RF/IF transformers including AM-IF, FM-IF, and TV-IF transformers.

The coil value for a shortwave converter depends on the input RF frequency. I used 3.5 μH for a 15-MHz WWV converter, which resonated with 33 pF. You can roughly scale the coil for your circuit using those values as a guide. Keep in mind that the inductance change is equal to the square of the frequency change. In other words, a 2:1 frequency change requires a 4:1 inductance change.

The tuned circuit must be resonant at the desired frequency. The resonant frequency is:

$$f = 1/(2\pi\sqrt{LC})$$

or, to find L when C and f are known use:

$$L = 1/(4\pi^2 f^2 C)$$

or, to find C:

$$C = 1/(4\pi^2 f^2 L)$$

where f is in hertz (Hz), L is in henries, and C is in farads. Keep in mind when selecting C that there will be some stray capacitance, so the actual capacitance needed to resonate the coil in the transformer is less than the calculated value. How much less can be found experimentally.

A neat little fact that some experienced hobbyists know is that you can use an IF transformer for the RF input transformer of circuits like Fig. 3. For example, for VLF circuits, a 455-kHz or 262.5-kHz IF transformer from an AM radio will work. For HF shortwave circuits, a 10.7-MHz IF transformer from an FM ra-

dio will work, and for low-band VHF circuits, television-IF transformers in the 49-MHz region work. In some cases, an external capacitor can be used to reduce the resonant frequency by shunting the coil.

Another useful trick is to look at the bottom of the transformer (the end normally hidden from view when the transformer is mounted on a printed-circuit board) and see if there is a little slot with a ceramic tubular capacitor inside. If there is, you can crush the capacitor with a small screwdriver and then either use an external capacitor to select the operating frequency, or use the transformer as a wideband (well, sort of) input coupler for the circuit.

The output transformer in Fig. 3 is similar to the input transformer, but will be tuned to either the sum or difference frequency (most often the difference frequency).

The local oscillator is a crystal-controlled circuit made using the MOSFET's gate-2 (G2) input. The crystal is selected based on the desired input frequency and the desired output frequency. For example, I once built a converter to place the 15-MHz WWV signal at 1 MHz in the AM-broadcast band so that the time station would appear on my car radio. A 16-MHz crystal for XTAL1, with a 15-MHz transformer at T1 and a 1-MHz transformer at T2 did the trick.

Sometimes, a single crystal will work for two bands if the input tuning at G1 is adjusted. On both frequencies, the difference signal is picked off, but in one case the RF is greater than the local-oscillator frequency, and in the other the RF is less than the local-oscillator frequency.

A more sophisticated circuit is shown in Fig. 4. In it, the same tuned input and output transformer circuits are used and the crystal is once again connected to G2. However, there is a third tuned circuit, composed of C3 and L3, used as a frequency trap to prevent the signal from the crystal oscillator from appearing at the output. That resonant-tank circuit is designed so that both the coil (L3) and the capacitor (C3) have a reactance of about 490 ohms at the crystal frequency, or mathematically:

$$L = 490/(2\pi f)$$

and,

$$C = 1/(490 \times 2\pi f)$$

For example, if the crystal frequency is 16 MHz, then the capacitor and inductor are 20 pF and 4.9μH, respectively, to make the reactance approximately 490 ohms.

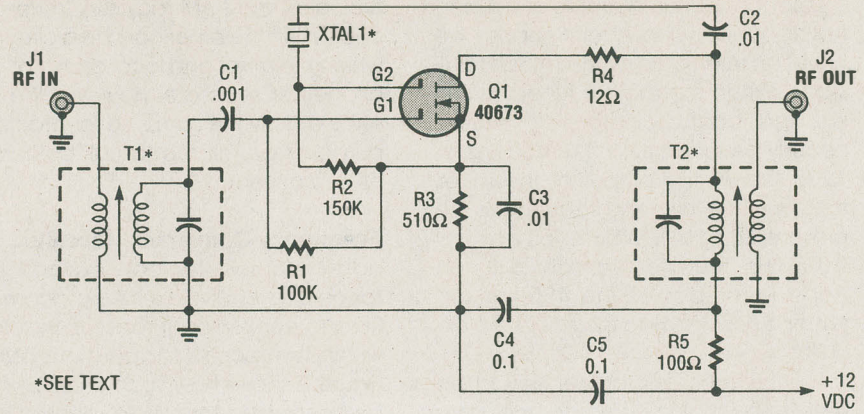


Fig. 4. This circuit is similar to that shown back in Fig. 3, but there is an additional filter used to attenuate the local-oscillator output.

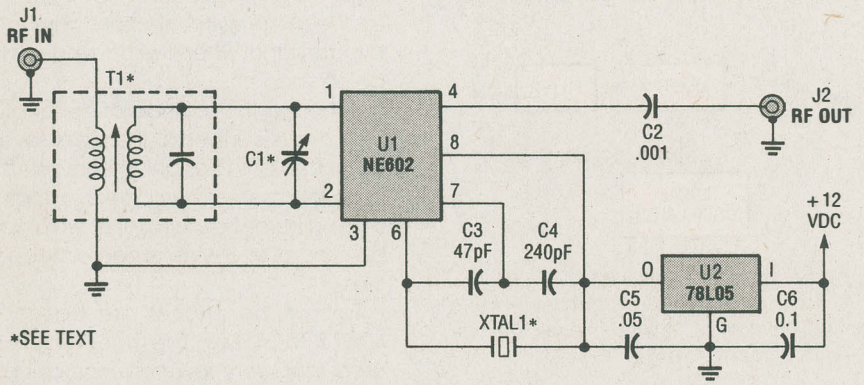


Fig. 5. A quick one-chip converter circuit can be made with the NE602 IC. It requires few components for support and can work over a broad range of frequencies.

Figure 5 shows an IC-based converter that can operate from VLF into the VHF region, using either a crystal or variable-frequency oscillator for the local-oscillator frequency source. In the case shown, the local oscillator is a crystal type. The IC used in the circuit, U1, is the Signetics NE602 double-balanced mixer, and it's a very good selection for many applications.

The input circuit is a tuned transformer. If the desired frequency is close to 10.7 MHz, then use a 10.7-MHz IF transformer and retune it either with its own slug-tuning control, or an external capacitor. Otherwise, crush the capacitor inside the transformer (as mentioned before) and use an external capacitor to resonate the circuit. You can also delete both the internal capacitor and C1 to make the input network wideband over a large segment of the high-frequency band.

The NE602 needs a power-supply between 4.5 volts and 8 volts. In the circuit of Fig. 5, a small 78L05 three-terminal IC voltage regulator (U2), with a 100-mA rating, supplies the required DC voltage. Alternatively, you can power the circuit with a 6-volt battery,

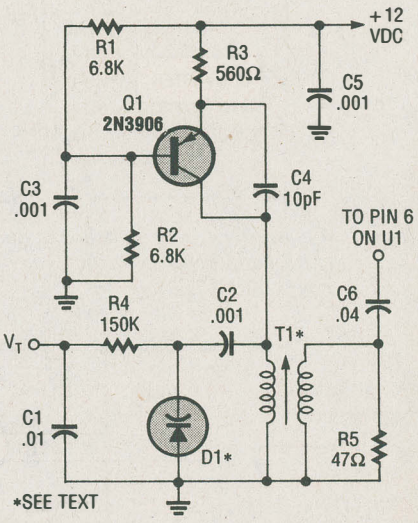
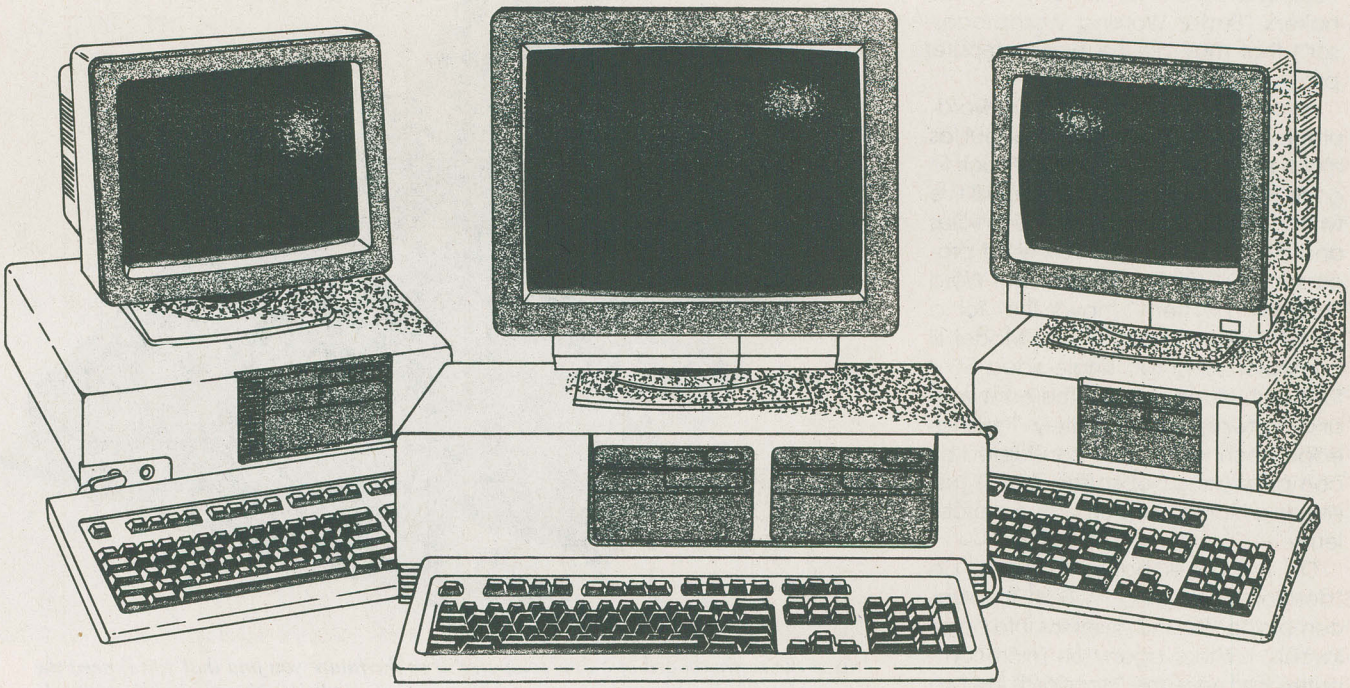


Fig. 6. You can make the circuit of Fig. 5 tunable by replacing its crystal-based local oscillator with this voltage-controlled oscillator. The operating frequency is determined by the voltage at V_T.

(Continued on page 84)

How To Choose A



COMPUTER

Don't be swayed by sales hype or fall into the trap of overkill. Learn to size up what you need before purchasing a computer

By Fred Blechman

Living in the 1990's, you probably fall into one of two categories: either you've already purchased a personal computer, or you're thinking about getting one. If you're in the first category, you already know the mistakes you've made, if any. If you're still thinking about getting a computer, read this first!

There are some good reasons to get a personal computer, but be careful about getting more power and "glitz" than you need. If all you need to do is word processing for personal correspondence, very simple equipment will do a fine job. So will a pencil, pen, or typewriter! On the other hand, if you own a small business, or you can't live without playing high-speed arcade games in 256 colors, you'll need a relatively sophisticated computer system.

Who Should You Listen to? Let's say all the advertising hype, or a well-meaning friend, have finally convinced you that you need a computer and maybe some add-on's (which computerists call "peripherals"). But before you make a decision, your common sense tells you the smart thing to do is to investigate the situation. You read ads, and go to computer stores and computer shows to ask questions. You may even try to read and understand some computer magazines.

Unfortunately, all that can be a waste of time. Computer ads are frequently so full of jargon that they are difficult to make any sense out of. At stores and shows you may not know enough about computers to understand what the fast-talking salesmen are telling you. Worse yet, a surprising number of salesman don't know much more than you do, but they've learned enough "buzzwords" to sound like experts. Most computer magazines are even harder to understand for just the opposite reason: they know what they're talking about. Long ago they stopped writing for the average person and began to cater to the "power user"—one who mostly uses his computer to do things he doesn't at all need, but which impress him and his associates. He is often times a master at solving problems that he doesn't have!

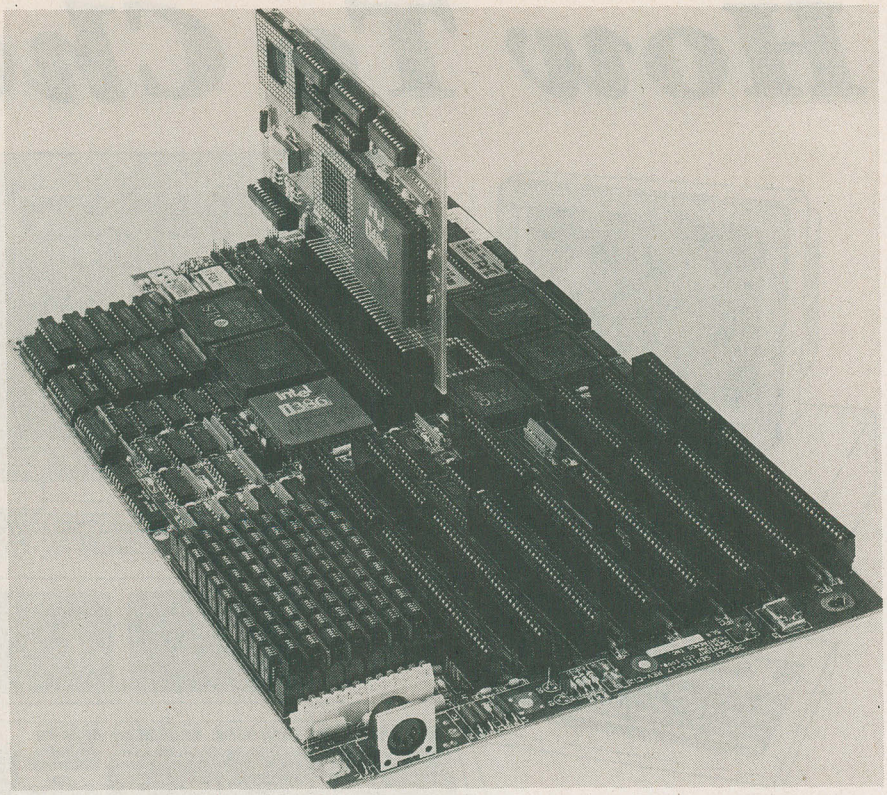
Unfortunately even good friends can lead you down the wrong path. A good example of well-meant, but misdirecting, advice from a friend or associate is "You must do your word processing with WordStar"—or Word Perfect, or Word, or Volkswriter, or any of dozens of $400-and-up word processing programs that happen to be *their* personal favorite.

Frankly, I'm appalled at how many people are using word processors (and all kinds of other computer programs)

that are gross overkill for their needs. Most word processing needs can easily be performed with under-$50 word processors. I recently found a word-processing program for under $30 (Spinnaker's "Better Working Wordprocessor") that may be the best computer program I've ever used!

For most users, getting a $400 word-processing program makes about as much sense as buying a Mack truck to go to the store for a loaf of bread! I've written hundreds of magazine articles and five books using a $59 word processor: "ZORLOF The Magnificent Word Processing System" (how's that for a name?) with an old TRS-80 Model III computer using two single-sided 5-¼" full-height floppy drives. This hardware and software are definitely "trailing-edge" technology, and considered by computerists as obsolete, but it just keeps grinding out stuff with no problems.

On the other hand, trying to do "desktop publishing," which involves combining text and graphics into page layouts, is sheer agony on microcomputers that were the "standard" just two or three years ago.



This is the motherboard of a 386 computer. If in the future you find that you'll need the power of a 486-based machine, you could always upgrade it with an expansion board (also shown here). The point is don't go for overkill; you can always upgrade later.

The Proper Approach. The biggest mistake new computer purchasers make is that they buy the hardware first and the software last. This is a no-no! The right approach to getting a computer is really just common sense. A computer without a program is nothing but a mess of wires, boards and electronic gimmickry. The program (or "software") is what makes the computer do its thing. But you can't find a program for your needs until you know what your needs are. Therefore, the first thing you should do is *determine your need(s)*. In the long run, that will help you decide what hardware and software you should get.

If you're in business, start by defining what it is now that you do on paper. Invoices? Inventory? Client sales letters? Accounting?

As you become familiar with the wild and wonderful things you think computers can do for you, you'll dream up fantasies of the computer doing your weekly payroll, paying bonuses, printing checks, calculating discounts, sending letters to your customers, automatically gathering your annual income and expenses and filling out your income tax forms, writing your will, generating an estate plan for your children, and leaving you so much free time you'll learn how to fly an airplane with a flight simulator. Yeah, sure!

Trust me, some things are best left to 3×5 index cards or simple ledgers. Don't throw away your manilla folders or file cabinets. And don't think you won't frequently wish you'd never heard of computers.

This is not to say that computers can't do all the things just described. They can, and do so everyday. But not without some effort and sometimes pain from you. It gets back to first defining your *present* needs, and going from there to what would be even better. You don't have to limit your thinking to just what you're doing now, but be aware that every new requirement will take time and money to implement.

After you've clearly defined what you need, look for the software/hardware combination that will do the job. Software does not work by itself; it needs hardware, and *vice versa*. Only by really trying software out can you determine if it meets your needs, and the software that meets your needs pretty well defines the necessary hardware.

Computer software stores and shows are a good place to try the software/hardware combination. Sometimes, unfortunately, you can't try before you buy. In fact, you'll probably go through several software purchases before you really find what you need.

Along the way, be careful that you don't get overcome with the rapture of technology and end up getting romanced into a bunch of software and hardware you may not need. Resist the salesman's desire to load you down with a hard-disk system, EGA or VGA graphics, multi-sync monitor, extra memory, turbo speeds, 2400-baud modem, joystick, mouse, and all sorts of wonderful things—unless you actually need them for your application. For one thing, they will complicate your life. For another, you can add what you may have overlooked later.

Hardware Hype. There is a bewildering selection of hardware available, and at prices that keep dropping. You can get an extremely powerful computer with a fast printer and a high resolution color monitor today for the same cost as a wimpy monochrome system with a slow printer two years ago.

I can recall back in 1978 that if you wanted a ready-made computer you had the choice of an Apple, Commodore PET, or Radio Shack TRS-80. None had more than 4K of memory, and only Apple offered a color screen.

(Continued on page 87)

A FLASHING LAPEL PIN for the HOLIDAYS



Express your holiday cheer with a colorfully decorated, flashing lapel pin

BY JERRY BAUMEISTER

Most of the time, people think of me as the quiet introverted type. So, naturally, every once in awhile, I like to do something a little strange just to keep them guessing. This very simple project fits into that category. It's not rocket science, but it does lean to a bit of extroversion.

This holiday season imagine a Santa or Rudolph stick pin with a blinking red nose peering out over your shirt pocket or swinging from your tie. Imagine what your boss, your teachers, or better yet, those extroverted people who always imply that there is something wrong with you because you aren't loud and obnoxious like them will think. The possibilities are endless and you can do it all without saying a word.

Building the project requires a standard paper clip, some hot glue or fast-setting epoxy, an LED, a small button battery, and a stick pin or another paper clip. The battery is a type DL162016 3-volt lithium button-type battery and the LED is a 2.5-volt blinking type. It is essential that the LED will work on 2.5 volts—some don't. Such LED's are available from Radio Shack (as part #276-036) and Jameco (part #XC5410). The stick pin can be purchased at most hobby or craft stores, or you can fashion one from another paper clip. Just remember that the pin has to be about 2.5 inches long.

Making Your Own. First cut one loop off a standard-size paper clip. It should be a U-shaped loop about one inch long and one-quarter inch wide. Position the loop flat against the base of the LED and wrap a turn or two of the positive lead around the U-loop as shown in Fig. 1A with the negative lead extending through the center of the U-loop. Solder the loop to the positive lead. Trim off the excess lead length as close as possible to the solder connection. Cover the solder joint and the entire base of the LED with a drop of hot glue or fast drying epoxy, resulting in the loop being firmly attached to the base of the LED.

Take the stick pin and coil the negative lead of the LED tightly around the pin (see Fig. 1B). Do this until the pin winds itself down to within a battery's width of the base of the LED. Actually, the spacing at the base of the LED should be a little wider than the battery. Solder the negative lead to the LED by flowing solder over the coils that now

(Continued on page 96)

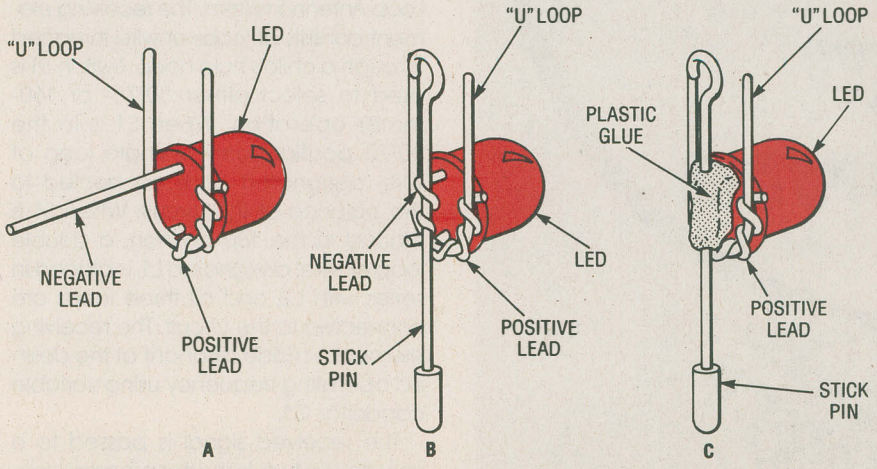


Fig. 1. Wrap a turn or two of the LED's positive lead around the U-loop (A), with the negative loop extending through the center of the loop. Coil the LED's negative lead around the pin (B), and solder. Then fill the space between the LED's base and the stick pin with glue (C).

Improve your reception on the lower frequencies with this easy-to-build, amplified-antenna system

BY DAVE HOLLANDER, N7RK

Improve Reception with a Dual-Band Loop Antenna

One of the greatest problems encountered when DX'ing on the lower frequencies—such as 1.8 and 3.5/3.8 MHz—is weak signal reception. That problem is compounded when one lives in a noisy location. Power-line noise can be a real deterrent and, in many cases, may even give rise to second thoughts about DX'ing on the lower bands. But a recent move to a new location allowed me to return to my favorite DX band (80/75 meters).

I put up a pair of phased verticals (¼ wavelength or about 62 feet on 80/75 meters) and, despite having underground utilities, was quite shocked to find an almost constant S9 noise level on 80 meters. The noise was coming from power lines located a couple of blocks away. Although the power company has been cooperative, an alternate receiving antenna was necessary as it can sometimes take them weeks, even months, to fix the problems. Besides, you never know when the noise is going to re-occur (usually when a *DX-pedition* is on from a country you have been trying to log for years).

There have been many schemes for receiving antennas. For instance, a "Beveridge" antenna (developed by and named for Harold Beveridge) would have been ideal. A Beveridge antenna is wire—a minimum of 1 wavelength long—stretched in the direction of the transmitting station, and generally erected only about 5–10 feet above ground. It has a bidirectional pattern if left unterminated. It is for receiving *only* and is useful for enhancing the signal-to-noise (S/N) ratio when listening to weak signals in high levels of atmospheric noise and interference. It is the most effective antenna for weak-signal reception on the 160- and 80/75-meter bands. But because of its size (approximately 260 feet for 80/75 meters, and 520 feet for 160 meters), it is not popular among city dwellers. Its size is crux of my problem; my backyard is a wee bit too small.

After studying antenna books, the *ARRL Radio Amateur's Handbook*, and various articles, I decided to build a receiving loop that could be placed inside my shack right next to the operating position. What follows is a very simple, easy-to-build, and inexpensive indoor receiving loop—the *Dual-Band Loop Antenna*—that covers both 80/75 and 160 meters. Changing bands is accomplished with the flip of a switch. If one is a good scrounger, it can probably be built for under thirty dollars.

About the Circuit. Figure 1 shows the schematic diagram of the Dual-Band Loop Antenna system. The receiving element consists of loops of wire threaded through a child's hula hoop. Switch S1 is used to select either 80/75- or 160-meter operation. When S1 is in the 80/75 position, only a single loop of wire, designated L2, is connected to the balance of the circuit. When S1 is placed in the 160 position, a double loop of wire, designated L1, is placed in series with L2, and all three loops are connected to the circuit. The receiving element is made resonant at the desired operating frequency using variable capacitor C1.

The received signal is passed to a very simple two-transistor preamp, consisting of Q1 (set up as a common-emitter amplifier) and Q2 (configured as a common-base amplifier). When S2 is

PARTS LIST FOR THE DUAL-BAND LOOP ANTENNA

CAPACITORS

C1—365-pF broadcast variable
C2—120-pF dipped-mica
C3—51-pF dipped-mica
C4, C5—.047-μF ceramic-disc

ADDITIONAL PARTS AND MATERIALS

Q1, Q2—3N3904, 2N4124, or similar general-purpose, NPN silicon transistor
R1, R2—150,000-ohm, ¼-watt, 5% resistor
R3—1000-ohm, ¼-watt, 5% resistor
L1, L2—See text
S1—SPDT toggle switch
S2—SPST toggle switch
B1—9-volt transistor-radio battery, or 6-12-volt power pack
J1—SO-239 or BNC chassis-mounted connector
Terminal strip or perfboard materials, metal enclosure, battery holder and connector, hula hoop, conduit fittings, antenna wire (see text), wooden base, solder, hardware, etc.

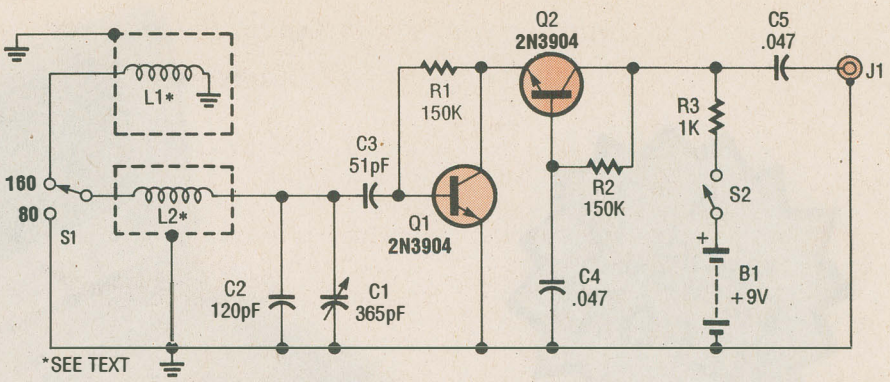


Fig. 1. The Dual-Band Loop Antenna consists of little more than three large loops of wire (L1 and L2), two transistors, and a few additional components.

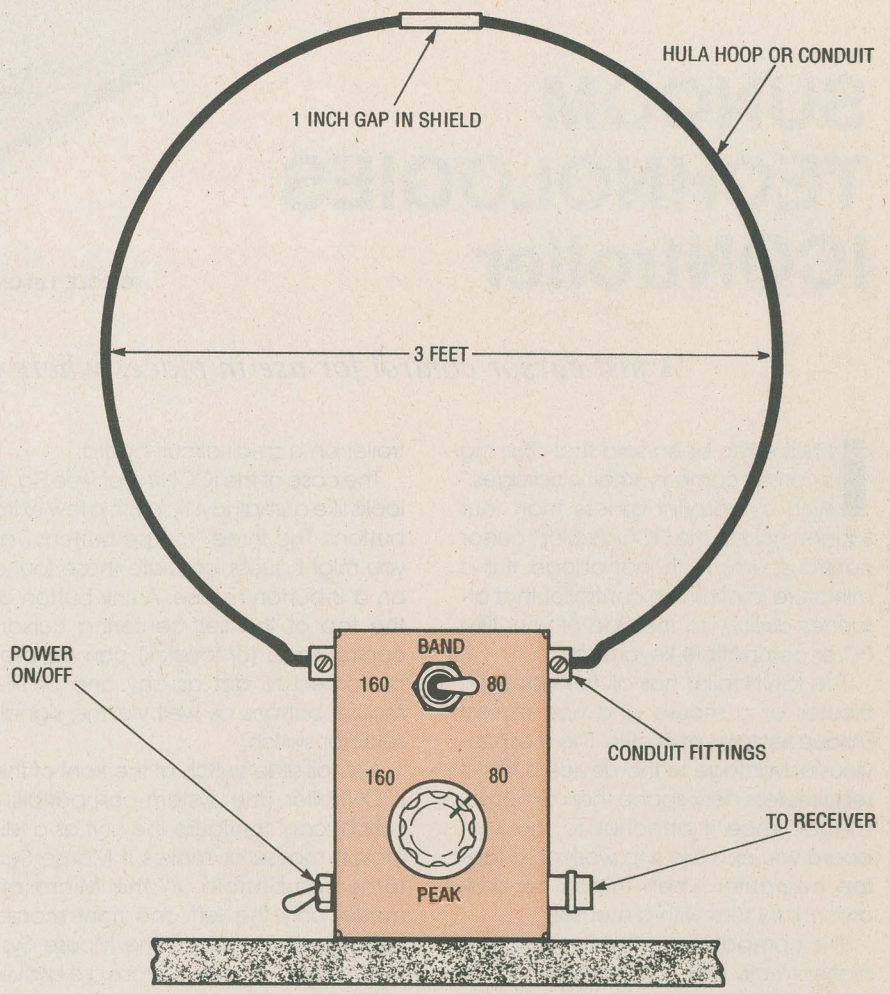


Fig. 2. The hula hoop is cut at the center of the exposed foil area and the ends brought into the metal enclosure through electrical-conduit fittings. The exposed foil is used to make electrical contact with the unit's metal enclosure.

turned on, a small voltage is applied to the base of Q2 through R3 and R2, turning that transistor on. With Q2 turned on, a small voltage is applied to the base of Q1 through R1, biasing it to just below turn on. The incoming signal, along with the bias voltage on Q1, is sufficient to cause Q1 to turn on and off as the incoming signal rises and falls. In that way, the incoming signal is used to modulate the DC voltage at the collector of Q2, producing an amplified version of the original signal at J1.

Power for the circuit is provided by a 9-volt battery, and because the circuit draws so little current, the battery should last at least a year if the circuit is turned off after an operating session. The circuit's operating voltage is not critical; in fact, the circuit could be powered from an inexpensive 6- to 12-volt plug-in power supply, if you wish.

Construction. The electronic portion of the author's prototype was built on a terminal strip, and housed in a metal enclosure (measuring about 2 × 3 × 5 inches), which was mounted to a wooden base to give the assembly stability. The antenna (loop) portion of the system was then mounted to the enclosure. That covers the overall construction of the antenna system, now let's take a more detailed look at the unit's construction.

The loops are housed in a child's hula hoop (which can be purchased at most toy stores). The hula hoop should be approximately three feet in diameter, although that dimension is not very critical.

The first step is to shield the hoop in order to eliminate electrostatic noise from power-lines and other sources. That's done by wrapping tin foil around the hoop and then covering the foil with electric tape, leaving about 2 inches of the foil exposed. Cut the hula hoop at the center of the exposed foil and then bring the ends of the insulated hula hoop into the metal enclosure through electrical-conduit fittings (see Fig. 2). The exposed foil will be used to make electrical contact with the circuit's metal enclosure.

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A Hands-on Electronics REPORT



SUNCOM TECHNOLOGIES ICONtroller

CIRCLE 119 ON FREE INFORMATION CARD

A fast cursor control for use in places where a mouse won't do

It has often been said that "the big surprises come in small packages." With a footprint of less than four square inches, the "ICONtroller" cursor control seems to fit that adage. It is a miniature joystick-like controller that attaches directly to the side of your IBM PC or compatible keyboard.

The ICONtroller has all the good attributes of a mouse and has several unique features of its own. The most obvious advantage to the device is that it requires less desk space than a mouse. Further, since it attaches to the keyboard you can use it to work on a laptop computer when there's no desk around; try that with a mouse!

It is compatible with any program that normally recognizes a Microsoft or Mouse Systems mouse, and can be used unmodified by either left- or right-handed users.

Description. The ICONtroller takes advantage of much of today's technology. Its brain is a Philips-Signetics 83C751 microcontroller that converts the user's requests into a 1200-baud serial-mouse format. It requires no batteries or power adapter, as it draws between 10 and 15 mA from the serial port. The microcontroller and support circuitry are mounted inside the ICONtroller on a small circuit board.

The case of the ICONtroller (see Fig. 1) looks like a small joystick with a few extra buttons. The three "mouse buttons," as you might guess, emulate those found on a 3-button mouse. A tiny button at the top of the self-centering cursor-control knob (or joystick) can be programmed to act as any one of the mouse buttons as well via the signal-selector switch.

A small slide switch at the front of the ICONtroller (the system-compatibility switch) can configure the unit as a Microsoft mouse or makes it Mouse Systems compatible. In the Microsoft mode, only the left and right mouse buttons are active; in the Mouse Systems mode, all three buttons are active.

Although the stick moves through a 360-degree circle, there are only eight directional switch locations, allowing vertical, horizontal, and diagonal cursor movement. Each of those switches has two steps to achieve two-speed cursor. Tilt the stick a little bit and the cursor moves one pixel at a time in that direction. Tilt the stick further and the cursor leaps forward at any of four faster speeds chosen with the cursor speed control. The speed control is electronically coupled to a small green LED that blinks from one to four times to indicate the selected fast-cursor speed each time it is changed.

All the switches are made of high-reliability conductive rubber, geometrically arranged to give the ICONtroller smooth action. The directional and button switches are rated for one million cycles, while the switch at the top of the stick is rated for 100,000 cycles.

Hardware Installation. The ICONtroller is designed for use with any IBM PC/XT/AT/PS2 or 100% compatible computer with a 9-pin or 25-pin RS-232 serial port. The ICONtroller cable has a 9-pin female connector and comes with a 9-to-25-pin adapter to support computers with 25-pin ports. Each of the female connectors, even on the 9-25 adapter, has finger-tightening knobs to screw the mating connectors together for solid contact. A well-written and liberally-illustrated 12-page booklet provides installations and instructions to help you with the hookup.

The attachment of the ICONtroller to your keyboard depends on whether you have the "desktop" or "laptop" version. The desktop ICONtroller uses a long, straight cord and adhesive clips to hold the cord along the back of the keyboard. A special double-sided ad-

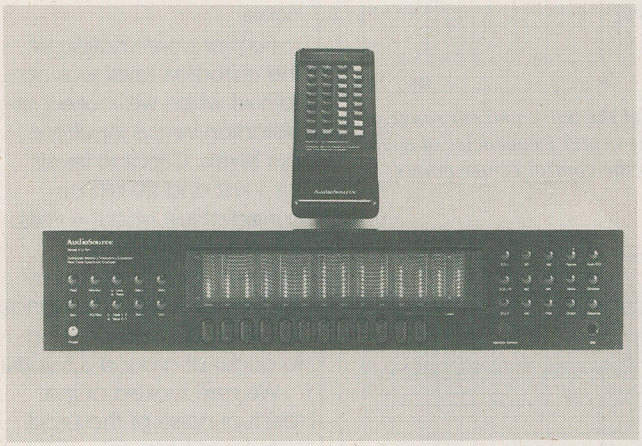
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PRODUCT TEST REPORTS

By Len Feldman

AudioSource EQ Ten Graphic Equalizer/ Spectrum Analyzer

Anyone familiar with home-audio installations knows that, more often than not, some tonal equalization is needed to make the system sound right. Of course, the simplest type of equalization involves the use of ordinary bass, treble, and, on some amplifiers, mid-range tone controls. But the action of such tone controls is usually too broad to do a proper job of equalization. To solve that problem, many manufacturers offer graphic equalizers, which are really nothing more than sophisticated tone controls that divide the audio spectrum into several increments, each of which is individually controlled by a button, slider, or knob. Dividing the spectrum in this way makes it possible to make very detailed corrections in frequency response where it is needed.



The AudioSource EQ Ten graphic equalizer/spectrum analyzer.

The problem with most equalizers of this type is that the user is left to his or her own devices when attempting to correct the overall frequency response of a system. That's where the AudioSource EQ Ten stands out among graphic equalizers. It is a fully electronic, 12-band unit with soft-touch controls, a built-in pink noise generator, and a calibrated electret microphone that will enable you to automatically adjust each band while results are displayed on its spectrum analyzer. The EQ Ten's onboard computer actually analyzes the acoustics of the listening environment and then sets precise equalization settings for optimum sound reproduction.

Alternatively, you can adjust each of the twelve bands manually to suit your personal preference. Favorite equalization curves can be stored in four separate memories and recalled at the touch of a button. Tape-to-tape dubbing and tape equalization are also possible with the EQ Ten. Once properly installed, the EQ Ten can be operated from your listening position using the supplied thirty-two function remote control.

CONTROLS

Above the small power button, at the lower left of the all-black front panel, are eight soft-touch button controls. They activate the pink-noise generator, select tape monitoring, select line or tape input, adjust spectrum-display sensitivity, adjust volume levels, insert equalization when making a tape recording, select dubbing mode (Tape 1 to Tape 2, or Tape 2 to Tape 1), and activate the microphone when using it to analyze the pink noise signal on the spectrum display.

The entire center section of the front panel is dedicated to the graphic/spectrum display. As a graphic indicator, it shows the cut or boost of each individual frequency band; the bands range from 25 Hz to 16 kHz. As a spectrum indicator, it shows the fluctuating output signal in each of the 12 frequency bands as sound passes through the equalizer. Below the display are equalization-level up/down controls. Each of these switches controls one frequency band, allowing the cut or boost to be manually varied by a total of ±12 dB.

To the right of the display are pushbutton controls for storing up to four equalization curves, selecting left or right channel equalization (each channel can be equalized independently with this unit), initiating automatic equalization, instantly restoring flat response, dimming the display, reversing the EQ (equalization) curve (useful if you want to play back an equalized tape recording to hear it with flat response), muting sound, and sequentially altering the display mode from holding highest levels on the display, to freezing the display, to operating continuously while in the spectrum-display mode. A microphone input jack is found at the lower right corner of the front panel.

The supplied remote control duplicates virtually all of the front-panel controls'

functions. However, to operate the equalization-level controls using the remote, you must first activate the band you want by pressing a special Frequency button and then altering the level using the EQ+ or EQ− buttons. The remote control is powered by two "AA"-size batteries.

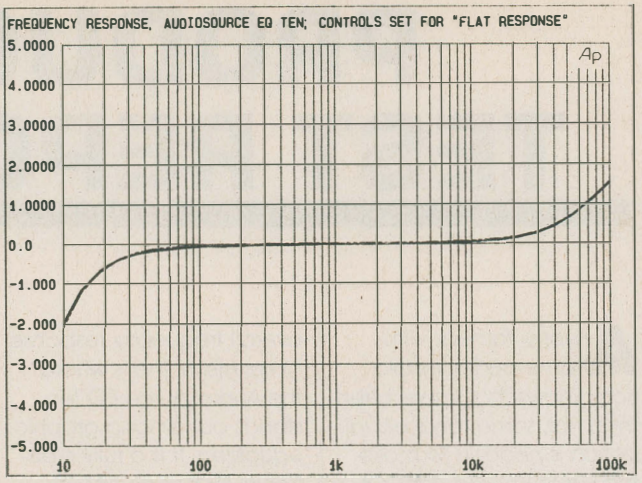
TEST RESULTS

We first looked at the overall frequency response of the EQ Ten when all controls were set for flat response. Deviation from a perfectly flat response under those conditions was no more than +0.2 dB and −0.6 dB over the range from 20 Hz to 20 kHz, though somewhat greater deviation was noted below and above the useful audio range.

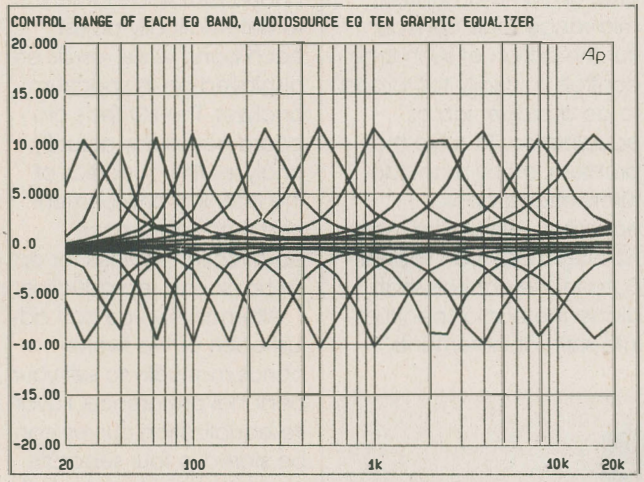
We next applied a series of 24 separate sweeps, superimposing one over the other while adjusting each of the EQ band controls to its maximum boost and maximum cut settings. Center frequencies of each band corresponded very closely to the control center points specified by AudioSource in their table of specifications. Control range was a bit less than the ±12 dB specified, but was certainly deemed adequate for the applications to which such an equalizer would be applied.

Another specification that deviated from the published specification was the unit's total-harmonic-distortion-plus-noise versus frequency. Using an output level of 1 volt, and with all EQ controls once again set to their flat positions, the THD plus noise remained fairly constant at 0.1% over the 20 Hz to 20 kHz test-frequency range. While that is considerably higher than the .008% specified by AudioSource, it is certainly acceptable.

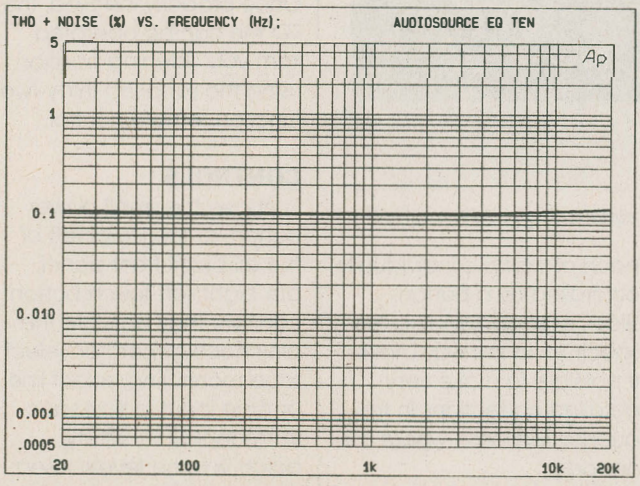
Nevertheless, in order to



Here's the overall frequency response of the AudioSource EQ Ten Graphic Equalizer/Spectrum Analyzer. For this test all of the equalization controls were set for flat response.



Successive sweeps were used to plot the boost and cut range of each of the EQ Ten's 12 bands. The center frequencies of each band corresponded very closely to the control center points specified.



This plot of harmonic distortion plus noise versus frequency showed that the THD plus noise remained virtually constant throughout the test-frequency range. At 0.1% it was certainly acceptable, although considerably higher than the .008% claimed by the manufacturer.

determine whether the readings obtained were the result of noise contributions rather than actual harmonic distortion, we conducted another test, using the Fast Fourier Transform (FFT) capability of our Audio Precision System One test equipment. Feeding a constant 1-volt, 1-kHz signal into the EQ Ten (with its EQ controls set for flat response), we did a spectrum analysis of the output. By allowing the test equipment to acquire the results in 16 passes, random noise is essentially canceled out, while actual harmonic components stand out in the resulting display. That display showed that the most prominent harmonic, at 2 kHz, was indeed at −60 dB relative to the fundamental 0-dB reference level. Since that corresponds to a distortion level of 0.1%, this test confirms the fact that the earlier readings were actually harmonic distortion and not contributions of random noise.

Further confirmation of the distortion level was obtained when we looked at distortion versus input/output levels. Clipping levels for 1 kHz and 20 kHz occurred at just about 4 volts, the maximum levels claimed for the EQ Ten by AudioSource. A 20-Hz signal, however, caused clipping to occur at around 3.6 volts.

We next looked at the residual noise of the product versus frequency, using a ⅓-octave tracking filter. Random noise was so low as to be totally inaudible under the conditions in which the product is likely to be used. Even the contribution of noise introduced from the power supply (at 60 Hz, 180 Hz, and 300 Hz) was more than 100 dB below the 1-volt reference level used in making the measurement. These results are actually somewhat bet -

ter than the −99.7 dB signal-to-noise level claimed by AudioSource. An overall, A-weighted measurement of S/N yielded a reading of −100.8 dB. A summary of these and other test results is shown elsewhere.

HANDS-ON TESTS

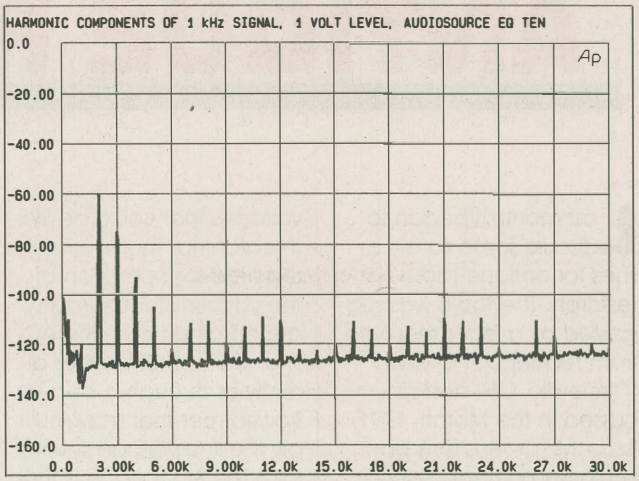
Setting up the AudioSource EQ Ten was relatively easy. We had used many graphic equalizers in the past and the easiest way to insert this one in the signal path of our system was via the tape-out/tape-in jacks on our reference integrated amplifier. Since the EQ Ten itself is equipped with a couple of tape monitor in/out loops, this method of connection did not deprive us of the use of tape monitoring facilities for our two analog tape decks in the system.

We were prepared for a somewhat tedious procedure when it came time to equalize our system/room acoustics, but were pleasantly surprised at how quickly and easily the automatic equalization was performed. Once the microphone was plugged in and the pink-noise generator was turned on, a push of the Auto EQ switch caused the built-in microprocessor to equalize the entire system in a couple of seconds! We allowed the EQ Ten to equalize each channel separately, as recommended by AudioSource and, not surprisingly, since the two speakers in our reference system were positioned some ten feet apart, the setting chosen by the EQ Ten for the left channel differed substantially from those chosen for the right channel.

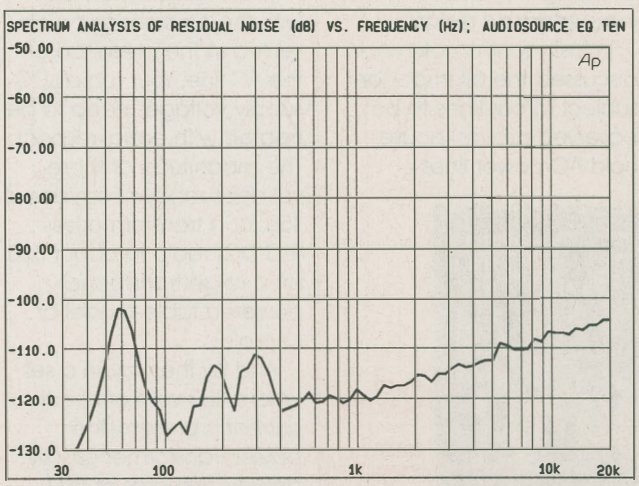
The equalized settings were stored in the unit's "memory" with the touch of two buttons. Both left- and right-channel settings were stored in a single memory location and were therefore recalled together whenever we wanted those settings. We found that the microphone position was quite critical during this operation, which made it important to use the remote control rather than the front panel controls to do the equalization procedure. We kept the microphone as close to our listening position as possible.

Of course, we experimented with the product by manually adjusting the EQ settings over a wide range. During these experiments we confirmed the advice given by AudioSource regarding over use of the extreme bass or high treble EQ controls. Using these controls for excessive boost can easily overload the capacity of your speakers or amplifier. Remember, a boost of 10 dB (easily within the capability of the EQ Ten) represents a power increase of 10-to-1, so go easy on the controls if you incorporate this or any other graphic equalizer in a home or professional sound system. And if you do use an equalizer such as this one, it's a good idea to keep other tone controls in your system in their flat position or, if possible, bypass or defeat them.

The AudioSource EQ Ten can take the drudgery (and inaccuracy) out of attempting to equalize a sound system. The product takes full advantage of the capability of modern microprocessors and turns a process that used to take as long as several hours into an accurate job that takes only a few seconds. For more information on the EQ Ten, contact AudioSource (1327 N. Carolan Ave., Burlingame, CA 94010) directly, or circle no. 120 on the Free Information Card. ■



This spectrum analysis of the harmonics of the 1-kHz, 1-volt test signal showed that the most prominent harmonic, at 2 kHz, is at −60 dB relative to the fundamental 0-dB reference level, corresponding to a distortion level of 0.1%. Note that the 1-kHz fundamental was notched out for this test.



This spectrum analysis of residual noise shows that noise levels are so low as to be inaudible under normal use.

TEST RESULTS—AUDIO SOURCE EQ TEN GRAPHIC EQUALIZER/SPECTRUM ANALYZER

Specification	Mfr's Claim	PE Measured
Frequency response	5 Hz to 120 kHz, ±1 dB	±2 dB
Gain (flat position)	Unity, ±1 dB	Confirmed
Distortion @1 V output	0.008%	0.1%
Hum & noise re: 1 volt	−99.7 dB	−100.8 dB
Maximum input/output	4.0 volts	(See text)
Input impedance	47K ohms	Confirmed
Output impedance	600 ohms	Confirmed
Control center frequencies	25, 40, 63, 100, 160, 250, 500 Hz; 1, 2, 4, 8, 16 kHz	Confirmed
Control range	±12 dB	+11, −10 dB
Pink noise output level	150 mV	Confirmed
Pink noise response	20 Hz to 16 kHz	Confirmed
Dimensions (W×H×D, inches)	16.5×3.5×8.75	Confirmed
Weight	7 lbs. 11 oz.	Confirmed
Price:	$429.95	

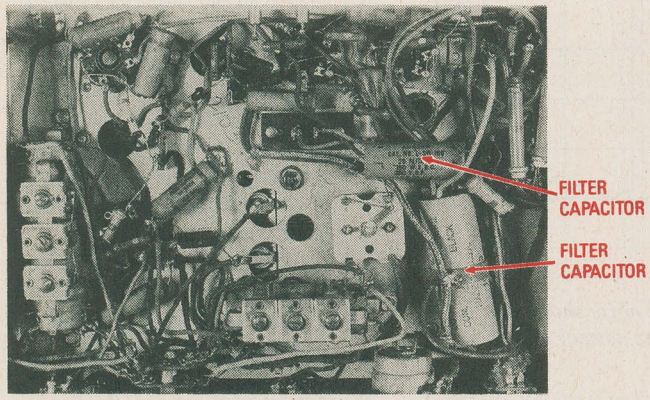
ANTIQUE RADIO

By Marc Ellis

Safety For Restorers: Part 2

Last month, I began to discuss some safety issues for antique-radio restorers. The topic was suggested by a letter received from reader D.K. Owens (Circleville, OH) and discussed in the March, 1991 issue. Mr. Owens was particularly concerned about the dangers lying in wait for newcomers to the hobby. And since I strongly agree with this concern, I've been directing my remarks to the inexperienced restorer.

In last month's column, I discussed the all-important subject of cautions to be observed around household AC power line-particularly when repairing or using AC-DC radios. This month, I'd like to talk about how to work safely around your radio's direct-current supply voltages. Then we'll finish up with some safety pointers concerning outside antennas.



The wiring of tube radios includes many high-voltage points. Filter capacitors (arrows) should be discharged before working on a set that has been recently powered.

DANGER—HIGH VOLTAGE!

Unless you specialize in crystal sets or early transistor radios, your restoration work is going to place you in close proximity to dangerously high voltages—voltages that could be life-threatening. Those voltages, required for operation of the vacuum-tube circuitry, are obtained from the AC-line wall socket—either directly or through a step-up transformer that may multiply the line voltage several fold. The AC voltage is then rectified (transformed to direct current), filtered, and distributed to various points in the receiver.

You're already familiar with the cautions to be observed in the presence of the AC line. Your radio's DC-supply voltages need to be treated with equal respect. The magnitude of these voltages ranges from about 150 for a transformerless (AC-DC) radio to about 350 for a large transformer-powered table-model or console.

And by the way, in a set where 350 volts of direct current is present, the power transformer usually delivers upwards of *800 volts* of AC to the rectifier circuit. Most people don't have to be told to be careful around such a voltage source!

And, because they have a feeling for the large amounts of current available at a wall socket (15 amperes or more), most people don't need to be convinced that the 117-volt AC line must be treated with respect. But they may not have as much respect for the DC operating voltages within a radio once they know that those voltages are available only at currents measured in *thousandths* of amperes.

Although this is not a medical treatise, and I'm certainly not an expert on the medical effects of electric shock, I can assure you of this: Even the lowest DC voltages used by AC-DC radios and battery sets are considered quite dangerous. Depending on the resistance that your body offers to the passage of electric current (which varies with the amount of moisture on your skin, whether current is passing through an open cut, etc.) and the path the shock takes through your body, it's possible for even a 150-volt (or smaller) shock to interfere with the action of your heart and cause death.

Admittedly, most people weather small shocks with no permanent effects, but would you want to risk being the exception? Receiving an electric shock is a very unpleasant experience at best. And the unexpectedness of it could startle you into causing a secondary accident as you jerk your hand away. For instance, you might come in contact with an even higher voltage, subjecting yourself to a stronger shock; you might pull the radio off the bench so that it drops to the floor; or—if holding a test probe—you might overload and destroy a piece of test equipment by touching the probe to the wrong circuit point.

AVOIDING HIGH-VOLTAGE SHOCKS

When we discussed avoiding AC line voltage shocks last month, one of the key points to understand was that the power company grounds one side of the line. Thus, if your feet happen to be grounded (as when standing on a damp basement floor in damp shoes) and you



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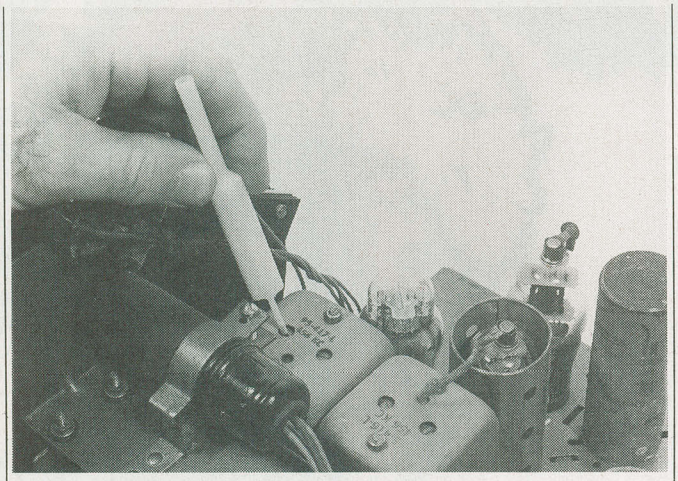
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IF transformer tuning screws (here being adjusted, as is proper, with non-conductive tool) may shock a beginner who touches them with a metal screwdriver.

touch a wire connected to the *ungrounded* side of the line ... ZAP! ... a rather hefty shock passes through your entire body. So the idea is to avoid electrical contact with the ground when working on live equipment.

Protecting yourself from your set's high-voltage DC supply is an analogous situation. Just as with the AC line, one side of the DC supply (called the B−) is grounded. In this case, though, ground means the metal chassis of the radio rather than the earth. The idea is to keep yourself from contacting the chassis and one of the high-voltage (or B+) distribution points at the same time. Otherwise, it's ZAP time again!

But you also have to be careful to avoid contact with earth ground. In the case of AC-DC sets, as you already know, earth ground and chassis ground can be one and the same. Even with non-AC-DC sets, earth ground can be connected to chassis ground through a leaky capacitor or (as is very common) through the ground lead of a piece of test-equipment whose chassis is connected to earth ground via a 3-prong plug.

The fear of becoming accidentally grounded is quite ingrained in the electronics experimenters who cut their teeth during the vacuum-tube era. Being one of them, for example, I find the idea of using a wrist grounding strap (worn to drain off static charges while working with sensitive integrated circuits) quite appalling—even though semiconductor equipment operates at very low voltages.

Because it is required in virtually every vacuum-tube circuit, high-voltage DC may appear anywhere above or below the chassis of the receiver you are working on. The high voltage may appear even in places where it wouldn't normally be expected. For example, as Mr. Owens pointed out in his letter, on the adjustment screws of early IF transformers.

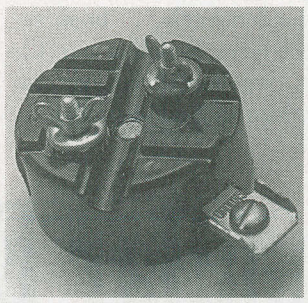
Defective components or improper modification by inexperienced "repairmen" could cause high voltage to appear in even more unlikely places. So unless you have positive information to the contrary, every metal part or connection should be treated as if it were live.

Through last month's discussion, you already know how to avoid being grounded through your shop floor. As an additional precaution against high-voltage DC shocks, some writers suggest keeping one hand in your pocket at all times while working on a live chassis. If you only have one hand involved, it's a lot harder to contact a ground point and a high-voltage point at the same time. And even if you did, the shock would be a lot less severe when passing through one hand only than if it flowed across your body through both hands.

Others (and I am one of them) feel that working with one hand is too clumsy and would be quite likely to cause other kinds of problems. I need both hands to stay out of trouble, and in well over 40 years of working with tube gear, I can't remember receiving even a single shock. For this, I credit my attitude—which is one of great respect for the working voltages associated with vacuum-tube circuits.

Another precaution that you definitely *should* take is to make sure that your tools have insulated handles. Of course, doing any kind of work on a live chassis is not recommended. However, if you must use a screwdriver, pliers, or other tool, make sure there is no exposed metal on or near the handle.

As a final caution, keep in mind that your chassis may not be free of high voltage even after you cut the power. The set's filter capacitors can store an electrical charge for quite a long time—enough of a charge to give you a nasty jolt hours after the radio is shut off.



Static discharge unit as sold by Radio Shack. The wing nuts are antenna connections; the screw on tab is for ground.

You would be well advised to short the leads of all filter capacitors to ground if you must do serious work on a set just after shutting it off. You'll hear a loud "snap" as the capacitors discharge, and you may see a spark as well. There are usually at least two filter capacitors, sometimes separate, sometimes combined in one can. Of course, you must be sure that the tool or clip lead you use for this purpose has an insulated handle.

ANTENNA SAFETY

Most serious collector/restorers eventually put up an outside antenna, and no introductory discussion of electrical safety would be complete without mentioning antenna hazards. There are two major ones: power lines and lightning. Avoiding them requires only simple, common-sense tactics. Ignoring them invites serious property damage, and very easily could cost you your life.

Most residential power distribution is handled via overhead lines operating at several thousand volts. Such lines are a major hazard to antenna installations. Never install an antenna so that it passes over one—not even the lower-voltage power line from the pole to your house. Don't even install the antenna in close proximity to a power line.

If the antenna wire should accidentally fall across a high-voltage line while you are putting it up, you'd probably be electrocuted instantly. Those lines have little or no insulation and, of course, antenna wire is a very good conductor of electricity. Even if you were able

to install an antenna wire near a power line without incident, the wire could easily later break in a storm, falling across the line and conducting lethal voltage into your home through the lead-in connection.

If your antenna uses one or more metal masts, be sure to ground them (use one of the systems designed for TV-antenna masts). Then a lightning strike will be more apt to travel through your mast and grounding system on its way to the earth than through your antenna, lead-in wire, house, equipment, and you!

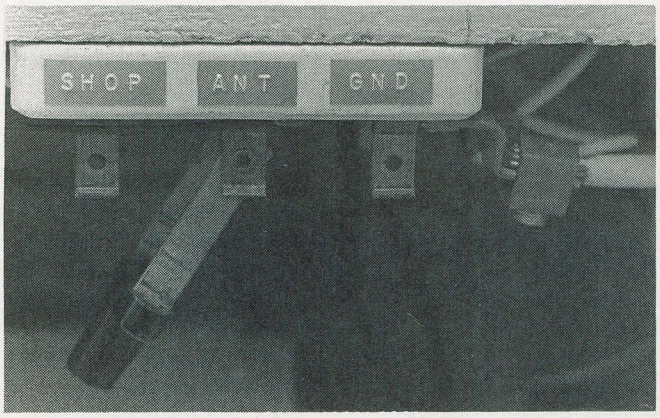
During electrical storms, buildups of static electricity in the atmosphere are more common than actual lightning strikes. The static charge can accumulate on an antenna until enough builds up to arc to ground, either through a receiver connected to the antenna (with destructive effects) or perhaps through an unlucky individual who happens to be handling the lead-in wire.

There are two simple ways to avoid that problem, and I'd suggest using both. (1) Use a static-discharge device, such as those sold for use with TV twinlead (attach your lead-in to one of the two antenna terminals and ignore the other one). When connected to a good ground, this device will continuously leak static charges to earth—therefore preventing dangerous buildup of static electricity. (2) Use a heavy-duty knife switch to transfer your lead-in wire to a good ground system whenever you are not using the antenna.

Just one final point. Everyone in your family should know that it can be extremely dangerous to try to rescue a victim of electric shock. If you touch the victim while he or she is still in contact with a live wire, you'll become a victim yourself.

It would be a wise move to set up your workbench with a master power switch and make sure everyone understands that it should be shut off before attempting a rescue. Also explain the possibility, remote that it might be, of contact with a power line via your antenna lead-in. Stress that rescue from such a situation should be attempted only by professionals.

That's all for this month. We want to be sure to see you all again next time, so please remember to work safely, and send your comments or questions to me at *Antique Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■



The antenna lead-in at my house is grounded, when not in use, through a heavy-duty knife switch. Note the large ground conductor at right.

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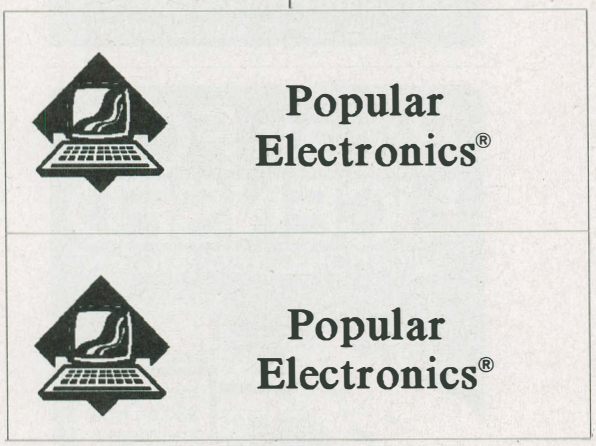
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By Jeff Holtzman

List and Label Fun

Seemingly simple print jobs, like mailing labels and address lists, can befuddle word processors, graphics, and desktop-publishing programs. What's really needed are small, focused utilities that don't try to be all things to all people, but rather try to do one job and do it well—and keep the cost down.

Recently I've been using a couple of complementary programs, Avery's *LabelPro* (which has but one purpose: to print attractive mailing labels, optionally including graphics) and *Books, Cards, and Labels* (which excels at printing database type phonebook listings in a multitude of formats) from Useful Software, Inc. Both of the programs stick to a "small is beautiful" philosophy.



LabelPro gives you several layout options—whether to include a graphic image (like the computer shown here), borders, or text—and provides a preview mode with several zoom levels.

LABELPRO

LabelPro comes in separate PC versions for laser and dot-matrix printers: I tested the laser version with an HP LaserJet Series II. A Macintosh version is also available. One of the most attractive features of LabelPro is that you can print labels with graphic images. The program comes with several dozen of its own, including balloons, computers, etc. You can also add your own images to LabelPro's image database. Images must be stored in PCX format, as produced by PC Paintbrush, the Paint program in Windows, and many other graphics programs. The dot-matrix version supports color printers; at this time of the year, that capability would be useful for printing colorful holiday cards.

One useful feature of the program is the ability to merge print labels from a database, which may be in dBASE, WordPerfect, or ASCII formats. LabelPro also has a built-in Data Manager with several predefined databases. However, you can't modify the built-in record structures. The Data Manager might suffice for small jobs, but you'll want a more efficient package to manage a database of any quantity.

Designing a label is simple. You first select a label format, of which the program supports about 30. The supported formats all correspond to labels that Avery sells, which include common address and shipping labels, round formats, formats for diskettes, audio and video cassettes, file folders, and more. You needn't worry about having to fit the predefined label formats, because Avery labels are easy to get hold of, both at local office-supply stores and by mail order.

For each given label format, the program gives you several layout options—whether to include a graphic image, borders, or text. Text can appear in two fonts (a serif font like Times Roman and a non-serif font like Helvetica), in numerous sizes, with italic or bold emphasis, and with various indentions and justifications.

Designing a label is intuitive. The program provides a preview mode with several zoom levels, so that you can see exactly what you're going to get. When your design is satisfactory, you can save it for reuse later. Printing is quick; the program apparently creates a bitmap of one label and then uses LaserJet macro commands to duplicate it across the page.

The documentation is pretty good, albeit a bit verbose. The package includes numerous sample labels and a special calibration sheet for real printing precision, although I had no trouble printing without calibrating my system. LabelPro requires about 1.3 megabytes of hard disk real estate.

I'm pretty happy with LabelPro as it is, but if I were going to revamp the program, I'd build a WYSIWYG (What You See Is What You Get) version that ran under Windows and provided precise control over all layout features.

BOOKS, CARDS, AND LABELS

BCL's claim to fame is its ability to print cross-referenced telephone directories in a wide variety of formats. Two versions of the program are available; one prints data stored in an external database, the other (the version tested) includes its own database

manager. Both versions support numerous laser and dot-matrix printers. Laser-printer support includes cartridge and soft fonts. The program comes with several so-so soft fonts of its own. BCL requires about one megabyte of disk space.

The database manager can import and export data in various formats, including dBASE, ASCII, SideKick, Black Book, Pocket Address Book, etc. The import procedure is rough and poorly documented; it had trouble aligning telephone-number fields without area codes correctly. BCL also has trouble handling foreign-address formats.

The built-in database includes the most extensive set of fields that I've ever seen in a canned list manager, including four names, five phone numbers, two addresses, four "code" fields, two notes fields, and more. There are lots of little extras that make the database structure powerful. For example, each telephone number has an associated single-character symbol that specifies the type. For example, B = Business, H = Home, F = Fax, and C = Car.

You can use the four "code" fields in a numerous ways to create subsets of your database. For example, I use the following: C = Commercial, E = Emergency, F = Friends, G = Government, H = Household, J = Job, K = Kin, M = Modem/BBS, N = Neighbors, and several others. I can then create a printout that lists, for example, only "E" (Emergency) numbers to post by the phone, another printout that includes CEFGHN for a home phone book, another one that includes CGJM for a business book, and so on.

BCL prints in a wide variety of formats, including some that are predefined for business planners (DayTimer, Franklin, etc.), and others that print on regular 8.5- × 11-inch sheets. A book format prints in landscape mode on both sides of the paper, allowing you to fold it in half, staple it in the middle, and *voila*, instant phone book. As the name suggests, BCL also prints mailing labels and Rolodex-style cards. It even prints envelopes, albeit without a return address. In addition, Useful Software sells special forms for various printers and planners at reasonable prices.

The documentation for BCL is pretty poor, so you'll have to rely on a fair amount of trial and error to get the printouts you want. Inexperienced database designers would also appreciate much more in the way of examples on the creative use of the various code fields. Another complaint is that navigating the menu structure and data-entry screens is difficult and inconvenient. Due to the multitude of fields on the entry screen, mouse support should be a high priority.

However, in spite of my complaints, I really do like BCL. After four years of procrastination, the program finally convinced me to clean up and consolidate my electronic phone lists. The company promises some updates soon, and I'll be looking forward to them eagerly! ■

VENDORS

Avery LabelPro ($99.95)
Avery, Commercial Products Division
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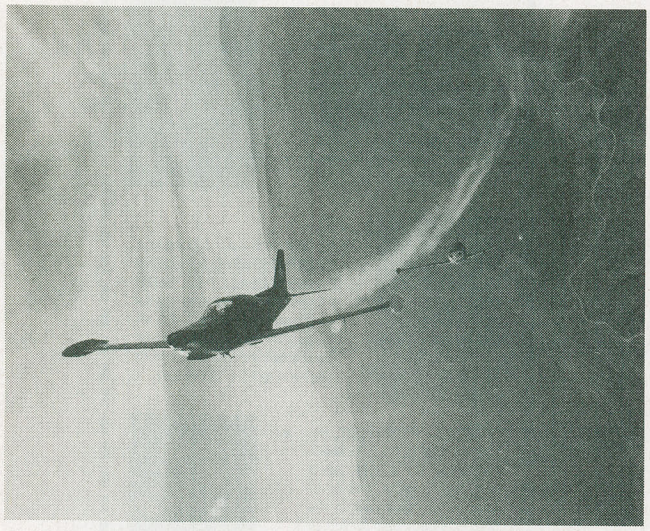
FUN SOFTWARE

By Fred Blechman

Flying the Real Thing

It has been forty years since I was behind the stick of a fighter plane, flying F4U-5 Corsairs with Fighter Squadron Fourteen (VF-14 "Tophatters"). However, since 1978 when I got my first microcomputer, I've flown every flight simulator I could get my hands on!

I have over 40 flight simulator programs for the IBM PC, and I have frequently reviewed the latest and greatest in this column. But, drawing back on my dim recollection of "real flying," I wondered how these simulators compared with modern flying and air combat. At age 64 it was unlikely that I'd ever fly a fighter again, so I chose the next best thing—I took a six-dogfight flight with "Air Combat U.S.A.," where you fly real airplanes in simulated air combat!



How do flight simulators stack up against the real thing? Take a flight with Air Combat U.S.A. and see for yourself.

This "Fighter-Pilot for a Day" program (three actual dogfights for $399, six for $495) operates from an airport about 60 miles from my Los Angeles area home. Flying Italian SIAI Marchetti SF-260W Warrior NATO light-attack planes in one-on-one mock combat, and using a patented electronic tracking system for determining "kills," this is as close as any civilian can come to the real thing.

Surprisingly, as I later found out to my chagrin, non-pilots can do this, and do it well! These planes have side-by-side seating, with dual controls. The "guest-pilot" flies in the left-hand seat, with an instructor-pilot in the right seat using the intercom to instruct the guest-pilot when needed.

I signed-up recently to be a guest pilot. After I got fitted with a flight suit (no G-suit), a hard-hat helmet and a parachute, we went into the ready room for a one-hour detailed briefing. "We" included, besides myself, my instructor-pilot (radio callsign "Hollywood"), the other guest-pilot (Larry), his son (Jim, who was giving his father the ride as a Father's Day gift), and my wife (Ev, who would be watching and photographing from an optional $100 Beech Bonanza chase plane). Larry's instructor-pilot, "Dooley," was out on the flight line checking the aircraft.

Hollywood described the various modern ACM (Air Combat Maneuvering) techniques, using model planes on sticks to illustrate flight paths. I don't recall ever hearing about "high yo-yos," "low yo-yos," and "displacement rolls" back in the early 1950's. These are vertical maneuvers we probably did without naming them—who remembers? Anyway, the briefing was very thorough and covered about a dozen typical offensive and defensive maneuvers.

Then we climbed into our neat 260-horsepower SF-260W's and strapped ourselves in. Hollywood made the take off after various radio and engine checks. I was amazed at the combined chatter with the tower, the chase plane, the other Marchetti, and on the intercom with Hollywood. I had a lot of trouble figuring out who was talking to whom.

Soon after takeoff we rendezvoused and I got to fly close formation—something I hadn't done in all these years, and that most civilian pilots never have the opportunity to do. Hollywood did the throttle jockeying while I worked the stick and rudder. As we approached the "combat area" for this flight (Lake Mathews, south of Riverside), I practiced S-turns to get the feel of the controls, while Larry in the other Marchetti dropped behind and, following Dooley's instructions, had some target practice getting me in his gunsight. Then we reversed positions and I got Larry in my sight a few times.

After some demonstration maneuvers, Hollywood let me take the first dogfight without any coaching. We climbed to 5500 feet and got in position to approach each other from opposite directions, passing wing-to-wing about 500 feet apart. I hauled my plane around the sky, craning my head inside the bubble canopy to keep the bogey in sight.

For the first time in forty years I was pulling well over 4-G, which I found very uncomfortable without a G-

suit. In Corsairs our G-suit started to inflate at 2-G. It took a couple of high and low yo-yos, and lots of buffeting and shuddering as the plane approached stalling several times, but I finally pulled the "enemy" into my sights, and squeezed the trigger on the joystick. A solid tone sounded in my headphones, a red light on the panel turned on, and the bogey plumed a stream of smoke. A kill!

My opponent, Larry Coles, is a 52-year old who had never piloted a plane. Following Dooley's prompting, he smoked me in the next three out of five dogfights! How do I know Larry, and not Dooley, was actually flying the plane? A VHS video tape is turned on at engine startup in each plane's cockpit, using two cameras (including a view through the gunsight), with all the radio and intercom yakking on the tape. Each guest-pilot gets to take his tape home. Larry sent me his tape, and he really was doing the flying! The rolling, twisting, yanking, banking, and G's didn't bother him at all. He even got to fly loose formation. Larry told me after the flight that this was the most exciting thing he had ever done in his life—and that he loved going on roller coasters. Aha! No wonder he wasn't G-sensitive.

Hollywood and Dooley took over and did some additional maneuvers as demonstrations, then we flew back to the airport and had a debriefing. Both cockpit tapes were shown simultaneously on two monitors so we could to see the offensive and defensive actions in each plane. Absolutely fascinating! Hollywood was cool and deliberate; Dooley was excited and having a ball with such a good student.

"Okay," you say, "that's nice for you. But how does this real flying compare with flying some of the newer PC flight simulators?" Well, there are several important differences and advantages to each. For one thing, a PC flight simulator doesn't cost $495 for six dogfights!

You don't pull any real G's in a flight simulator. True, some of the more recent programs, like the outstanding "Chuck Yeager's Air Combat," will dim and blacken the screen as your simulator pulls high G's, but you don't feel a thing. Believe me, pulling G's is tiring and effects your ability to yank the plane around.

Another big difference is the ability to see the other airplane. "Lose sight, lose the fight!" In a real plane, even though there are blind spots behind and below you, or under the wings, generally you can maneuver your plane and turn your head around to see the other guy. With most simulators you can't smoothly scan, as you would with your eyes, and you have absolutely no peripheral vision.

If you don't see the other plane, most simulators give you little or no information on him. If you don't know where the other plane is, and his apparent path, you're dead meat. On the other hand, the computer program always tells the enemy where you are, where you're headed, and your altitude, so you are at a definite disadvantage.

Also, although some simulators now include digitized voices, in a real plane there is a lot of on-the-air chatter that can be confusing and distracting.

You really can't get hurt in a simulator. Yeager lets you be "invincible." Various simulators let you use many weapons, fly defined or custom missions, and navigate between waypoints. Instead of just smoke you see bit-mapped fiery explosions with pieces flying every which way, just like the combat movies taken from real gun cameras. You can also practice landings—even carrier landings, such as with the great "JetFighter II." And you can always walk away from a crash.

In the final analysis, however, for us civilians there is really nothing to compare with the excitement and realism of Air Combat U.S.A. and "Sky Warriors," a similar East Coast operation that flies Beech tandem-seating T-34A Mentors. The experience is recommended. *(Air Combat U.S.A., 230 Dale Pl., Fullerton, CA 92633, Tel. 800-522-7590; Sky Warriors, 3996 Aviation Circle, Suite B-3, Fulton County-Brown Field, Atlanta, GA 30336, Tel.404-699-7000. The software mentioned can be ordered from any software dealer, or: Chuck Yeager's Air Combat, Electronic Arts, 1820 Gateway Drive, San Mateo, CA 94404, Tel.800-245-4525, $59.95; JetFighter II Advanced Tactical Fighter, Velocity Development, P.O.Box 875, Palatine, IL 60078-0875, Tel.708-991-0594, $69.95.)*

NEW FUN SOFTWARE

First, some news: Electronic Arts now offers product support 24 hours a day, seven days a week through a new 900 service (1-900-228-HINT) that uses pusn-button commands. It costs 95-cents for the first minute and 75-cents for each additional minute for hints and passwords for Electronic Arts' most popular titles.

Here are some recently announced programs that you can order from your regular software supplier. Suggested prices, where announced, are shown in parentheses.

Three-Sixty Pacific combines the action and suspense of a combat action game with the planning and wit of a strategic game in "Armor Alley" (IBM, $39.95; Macintosh, $49.95).

Mindcraft has released four products: "The Magic Candle Volume 2: The Four and Forty" is an adventure that has you exploring the dreaded realm of Gurtex, an ancient wellspring of evil (IBM, $59.95; Amiga and Commodore 64/128 to follow); "The Keys to Maramon" has you protecting the island town of Maramon from hordes of horrible monsters (Amiga, $49.95); "Breach 2" is a classic tactical space wargame (IBM, $29.95; Amiga, $49.95); "The Rules of Engagement" puts you in command of a fleet of starships in 24th Century strategic space combat (IBM and Amiga, $59.95).

Interstel has announced the availability of "Armada 2525," a multi-player space strategy game that pits players against five human or computer opponents in an interstellar battle to conquer the galaxy (IBM, $49.95; Amiga to follow). Also from Interstel, "Utah Beach" is the first of a series of wargames that allows the player to relive the famous battles of World War II (Macintosh, $49.95; IBM to follow).

Accolade has three new releases. "Elvira II: The Jaws of Cerberus" is a sequel to last year's critically acclaimed fantasy role-playing adventure (IBM and Amiga). "Mike Ditka Power Football" is a 256-color VGA simulation with realistic three-dimensional multi-angle player perspectives (IBM). "Les Manley In: Lost in L.A." is a graphic whodunit mystery adventure in which Les tries to determine who is kidnapping the biggest stars in Hollywood (IBM, $59.95). ■

By Joseph J. Carr, K4IPV

Build a Spectrum Analyzer

At one time, spectrum analyzers were found only in the most well-equipped engineering laboratories. Spectrum analyzers are devices that are used to display signal amplitude along the vertical axis and frequency along the horizontal axis on an oscilloscope's CRT. Such devices typically cover a rather wide frequency range. That allows them to "spot" signals over wide portions of the electromagnetic spectrum.

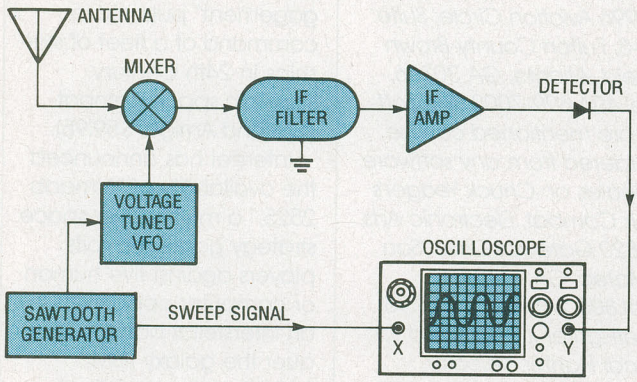


Fig. 1. Block diagram of a spectrum analyzer.

HOW IT'S USED

Federal Communications Commission (FCC) engineers use spectrum analyzers to keep track of signals within an area by detecting stations as they come on and go off the air. They also use spectrum analyzers to see how much second and third harmonics are being radiated from a transmitter; the less, the better. A spectrum analyzer can also be used to determine the effectiveness of a transmitter's tuning circuitry, or to test the effectiveness of antenna-tuning units.

In addition, spectrum analyzers might be used to find the source of electromagnetic interference. When intermodulation occurs, any number of frequencies might be involved. A spectrum analyzer allows the engineer to correlate signals on the CRT with the interference.

Another use for the spectrum analyzer is as a panadpter. Basically, a narrow-band spectrum analyzer that's designed to operate at the intermediate frequency (IF) of a receiver, it is connected between the output of the mixer and the input of the first IF filter. The panadapter allows continual visual monitoring over a narrow band of frequencies centered around the receiver's IF, allowing you to analyze the spectral content of a single received signal, or it can be used to analyze spectral content over a larger band of frequencies (up to a few hundered kHz). One use for a panadapter in ham applications would be to look for quiet spots on a band.

HOW IT WORKS

Figure 1 shows the block diagram of a typical spectrum analyzer. The input is coupled to an RF mixer, where it is mixed with the RF output of a local oscillator (LO) that consists of a voltage-tuned, variable-frequency oscillator (VTVFO), whose instantaneous frequency is controlled by the output of a sawtooth generator; that signal also controls the X-axis deflection on the oscilloscope.

The output of the mixer circuit is filtered to retrieve the difference frequency (RF – LO), or IF, of the analyzer. The output of the filter is then amplified and fed to a detector to produce a DC level. As the LO signal mixes with the incoming RF, deflections or "blips" on the trace indicate the spectral content of the band of interest.

SAMPLE HOMEBREW CIRCUIT

Figure 2 shows the schematic diagram for a simple spectrum analyzer, whose RF front-end is built around an NE602N double-balanced mixer (U1). (The NE602N is available from Digi-Key Corp., PO Box 677, Thief River Falls, MN 56701-0677; Tel. 800-344-4539.) The NE602N's internal oscillator is used as the VTVFO in this circuit. Its configuration is similar to that used in the band sweeper discussed last month.

Applying a sawtooth waveform to V_t causes U1 to sweep from the frequency obtained when the sawtooth is zero up to the frequency obtained when the sawtooth is at its maximum value. The signal produced by U1's internal oscillator as a result of the applied sawtooth waveform is mixed with the incoming signal from the antenna (ANT1), which is coupled through a pair of coils (L2 and L3) to pins 1 and 2 of U1.

There of two options for L2 and L3. The first option is to use a 10.7 MHz, transistor-radio type, IF transformer (IFT) for L2 and L3. To use the IFT in that capacity, the small capacitor must be removed (or crushed). The IFT windings must then be reversed in the circuit; that is the primary of the IFT is connected as the secondary and *vise-versa*. The

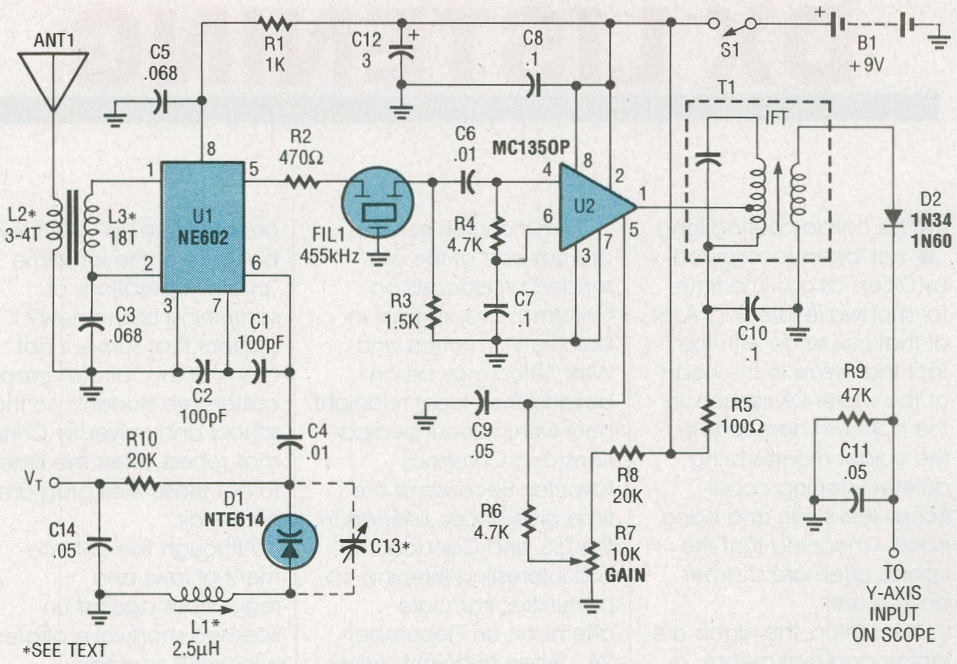


Fig. 2. The schematic diagram for the spectrum analyzer circuit. The circuit is built around an NE602N, which is supported by several semiconductors and passive components.

second option is to wind your own coils. The two coils can be wound on a single a T-37 or T-50 red or yellow torroidial core in transformer fashion. First wind 18 turns of #26 enamel coated wire on the core for L3. For L2, wind 3 to 4 turns of the same wire on the core.

The output of U1 (the difference or IF signal) is applied to FIL1—a 4-kHz wide, 455-kHz (center frequency), AM ceramic filter (also available from Digi-Key), which determines the circuit's IF range. From FIL1, the IF signal is fed to U2 (an MC1350P RF/IF amplifier) for amplification. The output of U2 is coupled to D2 (a 1N34 germanium diode), which is used as an AM detector, via T1 (a 455-kHz IF transformer), and is applied to the Y-axis of an oscilloscope.

Diode D1, an NTE614 varactor diode with a capacitance of 33-pF, allows U1's internal oscillator to be tuned from 10 MHz to 15 MHz. The varactor diode used in your unit will depend on the frequency coverage desired. For many HF circuits, diodes

PARTS LIST FOR THE SPECTRUM ANALYZER

SEMICONDUCTORS
U1—NE602 double-balanced mixed, integrated circuit
U2—MC1350P RF/IF amplifier, integrated circuit
D1—NTE614 33-pF varactor diode
D2—1N34 or 1N60 germanium diode

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—1000-ohm
R2—470-ohm
R3—1500-ohm
R4, R6—4700-ohm
R5—100-ohm
R7—10,000-ohm potentiometer
R8, R10—20,000-ohm
R9—47,000-ohm

CAPACITORS
C1, C2—100-pF, ceramic-disc
C3, C5—.068-pF, ceramic-disc
C4, C6—.01-µF, ceramic-disc
C7, C8, C10—0.1-µF, ceramic-disc
C9, C11, C14—.05-µF, ceramic-disc
C12—3-µF, 16-WVDC, electrolytic
C13—See text

INDUCTORS
L1—2.5-µH (see text)
L2—See text
L3—See text
T1—455-kHz IF transformer (Digi-Key part #TK-1301 or equivalent)

ADDITIONAL PARTS AND MATERIALS
FIL1—455-kHz ceramic filter (Digi-Key part #TK-2330, or similar)
B1—9-volt transistor-radio battery
S1—SPST switch
Perfboard materials, enclosure, Amidon L-57-2 or similar insulated coil form, battery holder and connector, etc.

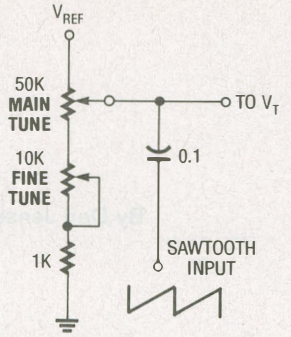
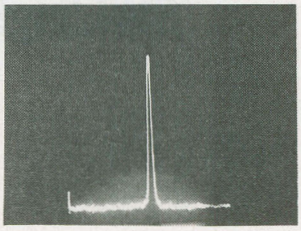


Fig. 3. Here's an alternate tuning network for the spectrum analyzer.



This trace shows a single frequency from a signal generator.

with maximum capacitances of 33 pF, 100 pF, or 365 pF are exceptable, but keep in mind that the frequency change is the square root of the capacitance change. Inductor L1, a 2.5-µH homebrewed unit wound on an Amidon L-57-2 shielded coil form, must resonate at the desired frequency, given the capacitance of D1. The number of turns needed for L1 depends on the wire diameter used and will have to be determined experimentally. To reduce the frequency range, or custom tailor the circuit's tuning range, a fixed or variable-trimmer capacitor (C13) can be shunted across D1. The value of C13 depends on the desired tuning range.

ALTERATIONS

The V_t input to the circuit can be altered, as shown in Fig. 3, so that a DC voltage can be combined with the sawtooth waveform. That would allow the center fre-

(Continued on page 89)

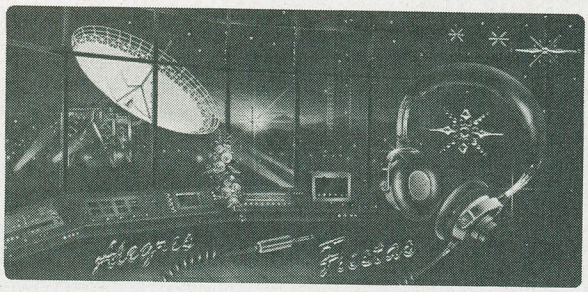
DX LISTENING

By Don Jensen

'Tis the Season for SWL'ing!

The holiday period long has been recognized by DX'ers as a prime time for shortwave listening. A lot of that has to do with the fact that we're in the heart of the winter DX season. In the northern hemisphere, the colder months bring quieter listening conditions—less static and band noise—meaning that the signals often are sharper and clearer.

In addition, the nights are longer and that means more opportunity to tune the lower frequencies, the so-called nighttime shortwave bands that require paths of darkness between the stations and the listener's location. And in addition to improved listening conditions during the Christmas/New Year holiday period, there are opportunities to hear stations that you otherwise might not log too readily.



"Alegres Fiestas," or happy holidays, is the wish expressed on this modernistic and electronic greeting sent to SWL's by Colombian shortwave station, La Voz de Yopal.

Christmas Eve, for instance, is a good opportunity to tune in Spanish-speaking stations of South America. Some Latin stations that normally sign off earlier in the evening will stay on the air later to broadcast Roman Catholic midnight Mass from local churches or cathedrals.

Even if church services are not part of the extended broadcasts on Christmas Eve, stations in both Latin America and West Africa may be on beyond their local midnight hour with musical dedications and Christmas favorites. Because of the time differences, listeners in the U.S. and Canada can find interesting listening opportunities from late afternoon on December 24—when midnight arrives in West Africa—to the late night hours when South American stations are still on the air. The programs, of course, are primarily for domestic audiences, so the broadcasts will usually be in a language other than English, with the exception of some African countries, such as Nigeria.

Although the larger international shortwave broadcasters—those high-powered outlets that regularly beam transmissions to North America—probably will not be expanding their scheduled hours during the holiday period, they no doubt will offer special Christmas programming.

How do the Dutch, Swiss, Austrian, and Swedish Christmas traditions differ from our own? Listen to Christmas concerts by organists in some of Europe's magnificent cathedrals, by some of the continent's finest philharmonics. International broadcasters usually offer plenty of special holiday programming with a local flavor.

For those intrigued by tuning in the unlicensed "pirate" shortwave stations, the holiday period offers a good number of listening targets. Who knows which ones will turn up? Will they be some of the longtime "pirate" operations or something brand new? I suspect that some, if not many, of the "pirate" broadcasters are students, so the school and university Christmas recess offers the time to get those illicit programs on the air.

Although the enforcement of laws and regulations against unlicensed shortwave pirates is (at best) sporadic, Federal Communications Commission monitoring seems even more lax during the holiday season. In short, the bootleg broadcasters have recognized that they can get away with it easier and more safely during the Christmas-New Year period. So if you're looking for those holiday "pirates," a good area of the bands to patrol is between 7,400 and 7,600 kHz during the late afternoon and evening hours.

In Europe—where unlicensed operators have been doing their thing for longer than their counterparts on this side of the Atlantic—there are often special tests arranged for North American SWL's during Christmas time. They, like their Yankee counterparts, use mostly low-powered transmitters. So it is rare that European pirate signals actually make it across the ocean. However, each season, U.S. and Canadian SWL's living on the eastern part of the continent usually manage to log one or two of those special transmissions.

Christmas tests by British and Continental European "pirates," or "free radio" as they prefer to be called,

concentrate mostly around 15,000 kHz during our daytime hours; around 6,200–6,400 and 7,400–7,600 kHz during our nighttime.

STOCKING STUFFERS

Okay, SWL's, tune out now! This segment is for your spouse who is looking for a little SWL gift to tuck into your Christmas stocking. I presume that most of the holiday shopping is already done. If the plan is to buy your SWL'ing partner that portable SW receiver, I imagine that the purchase already has been made. What I'm talking about here is the relatively inexpensive gift that you can order by phone at the last minute.

How about an SWL clock? Every listener needs one to keep tabs on the time as he or she listens. Preferably, it should be a digital type that displays hours in the 24-hour system (with the P.M. hours displayed as 13:00 to 24:00). The MFJ-109 is such a clock, with a dual display that shows both local time and Universal Coordinated Time—the "UTC" international reference standard used by foreign broadcasters and SWL's. It has a 24-position slide switch to show the local time in major world cities. The MJF-109 is battery powered, has an alarm, and is smaller than a paperback novel. It costs under $20 and can be purchased from Universal Radio (800-431-3939).

The 1991 *Passport To World Band Radio* (a 400-page SW station listing) available in English and other languages gives frequencies and schedules in easy-to-use chart form. One of the best of its kind, it also contains reviews and information on shortwave receivers that are on the market today. A must for every serious listener, it is priced at around $15 and is available in many book shops and electronics dealers, including Grove Enterprises (704-837-9200).

Another book for those who tune the shortwaves to find out what's happening around the globe is *Muzzled Media*. Its theme is how you can keep up with world news, as it happens and from where it happens, through international broadcasting. It can be ordered for about $9 from the publisher, *Tiare Publications* (414-248-4845).

Gilfer Shortwave (800-445-3371) has logging-report forms that are both inexpensive and useful for keeping written records of all the stations that an SWL tunes.

Your favorite SWL can automate his listening with a Novex RC2010 cassette controller. It works with many popular Sony, Panasonic, Sangean, and Realistic portable receivers with clock-timer units. In conjunction with a cassette recorder, it allows a listener to automatically record SW programs while away from home or sound asleep. The cassette controller is available for about $40 from Electronic Equipment Bank (800-368-3270).

And for those chilly winter mornings when your SWL'er drags out of bed to tune in some elusive Asian broadcaster, perhaps a sturdy, attractive coffee mug would be the ticket. Universal Radio (see above) has a nice one—blue ironstone ceramic with a map illustration and the slogan, "Listen to the World"—for under $5. With those suggestions, I add my wishes for a happy holiday season for all SWL's and their families!

DOWN THE DIAL

This is the section of our monthly column devoted to what's on the air, and when and where you can tune to find the stations. All times are given in Universal Coordinated Time (UTC).

As always, I welcome your listening tips, as well as your comments and questions about SWL'ing. And while you're at it, send along a photo, if you wish, showing you and your SWL'ing setup. I'll be running as many of those as I can in future columns. Write to *DX Listening*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735.

BANGLADESH—15,208 kHz. *Radio Bangladesh* at Dacca is noted in the eastern U.S. on this frequency, not the announced 15,200 kHz, at around 1230 UTC. A parallel frequency, 17,750 kHz, is usually covered by interference.

MALTA—9,765 kHz. The *Voice of the Mediterranean* broadcasts from this island nation with English programming that is heard at around 0645 until a language change at 0700 UTC. There may be some interference, however.

PORTUGAL—9,705 kHz. *Radio Portugal International* has been heard with its English transmission, news and weather plug, and Portuguese folk music before its 0230 UTC signoff.

TAHITI—11,825 kHz. *RFO*, which is "shorthand" for *Societe National de Radio Television Francaise d'Outre Mer*, at Papeete on this mid-Pacific paradise operates on this frequency during the late-night hours in North America. Listen in during the 0500 to 080 UTC period for programming in French and Tahitian, including some wonderful island music! ■

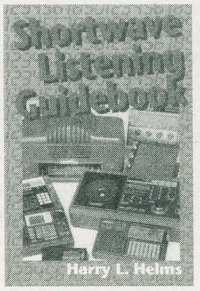
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Shortwave Listening Guidebook

by Harry Helms

The world is talking on shortwave radio, and here's the book that tells you how to listen in! In direct, nontechnical language, Harry explains how to get the most from your shortwave radio. Its 320 heavily illustrated pages are filled with practical advice on:

- **antennas**
- **when and where to tune**
- **selecting the right radio for you**
- **accessories**
- **reception techniques**



Learn how to hear the BBC, Radio Moscow, ham radio operators, ships at sea, even Air Force One! Includes hundreds of frequencies for stations around the world and the times you can hear them.

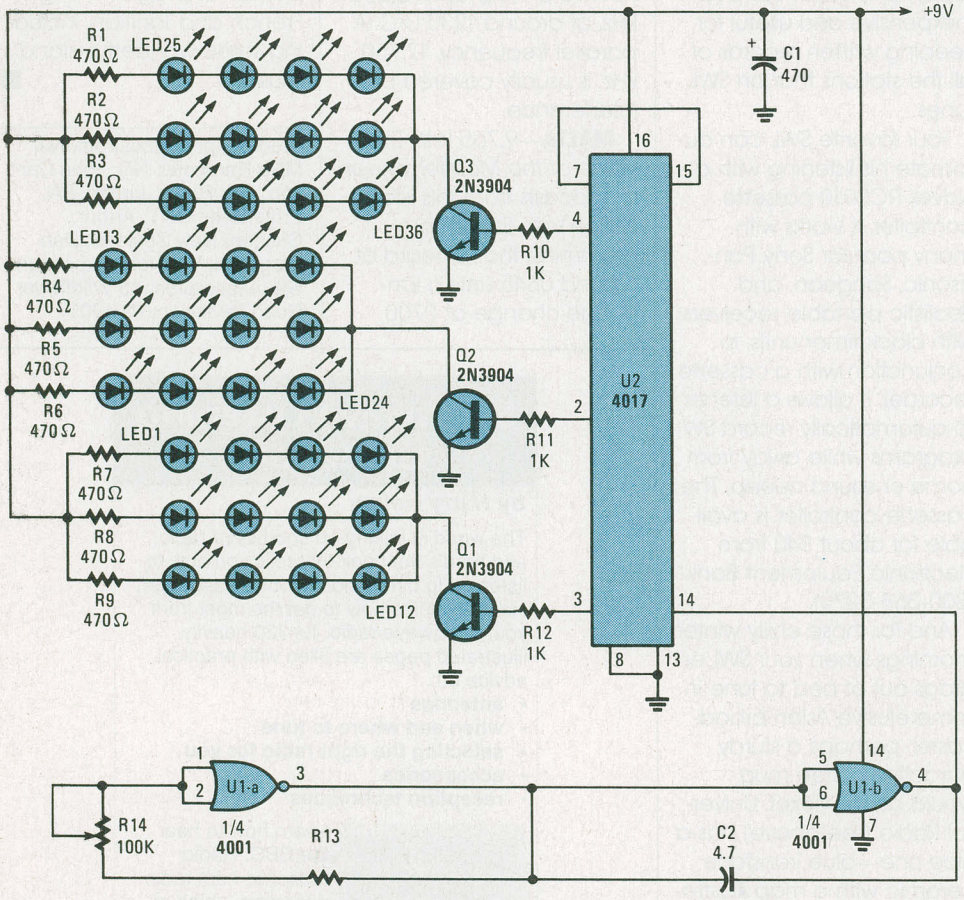
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By Charles D. Rakes

Take an Electronics Holiday

Seasons greetings circuiteers! In keeping with the season, we are going to share a pair of fun circuits. Our first circuit is an animated bell, consisting of several LED's arranged so that they form a three-bell outline. The bell arrangements are electronically controlled so that the lighting sequence gives the appearance of movement. It's just perfect for the coming holiday.



ANIMATED BELL

Figure 1 is the schematic diagram of the bell animation circuit. Each of the three bell outlines in the circuit consist of twelve LED's. As each group of LED's is sequentially switched on and off so that the bell outline appears to shift positions, creating the illusion of movement.

To accomplish the apparent animation, two gates (U1-a and U1-b) of a 4001 CMOS quad 2-input NOR gate are configured as a low-frequency astable oscillator, with its operating frequency set by the values of C2, R13, and R14. The circuit's oscillating frequency can be altered by adjusting R14. The oscillator output at pin 4 of U1-b is fed to the clock input of U2 (a 4017 CMOS decade counter/divider) at pin 14. Counter U2—which has 10 decoded outputs, but is connected in a count three and recycle configuration—advances one count per pulse, causing pins 3, 2, 4, and 7 (which correspond to outputs 0–3) to sequentially go positive.

The first clock pulse forces pin 3 of U2 high, turning on Q1. That grounds the cathodes of LED's 1–12, causing them to light, producing the first bell outline. The second pulse forces pin 2 of U2 high (and pin 3 low), which, in turn, causes Q2 to turn on, and Q1 to turn off. With Q2 turned on, the second set of LED's (LED's 13–24) light, causing the bell outline to appear to have shifted positions. The third pulse turns Q2 off and Q3 on, lighting the third set of LED's, and gives the appearance that the bell outline has once again shifted.

On the fourth clock pulse, pin 7 of U2 (which is tied to U2's reset terminal at pin 15) goes high. That causes U2 to reset to zero, once again causing pin 3 to go high, lighting the first bell outline, and the sequence is repeated.

Figure 2 shows the basic overlapping three-bell outline. However, if more bell outputs, connect U2's reset input at pin 15 to the output pin that's one greater than the number of bells that are used in your display.

For instance, if you want to used five bells instead of three, you'd have to connect pin 15 to output 5. (Remember output 0 at pin 3 is the first output to go

PARTS LIST FOR THE ANIMATED BELL

SEMICONDUCTORS

U1—4001 quad 2-input NOR gate, integrated circuit
U2—4017 decade counter/divider, integrated circuit
Q1–Q3—2N3904 general-purpose silicon NPN transistor
LED1–LED36—Light-emitting diode

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1–R9—470-ohm
R10–R12—1000-ohm
R13—47,000-ohm
R14—100,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS

C1—470-µF, 16-WVDC, electrolytic capacitor
C2—4.7-µF, 16-WVDC, electrolytic capacitor
Perfboard materials, enclosure, IC sockets, 9-volt power source, wire, solder, hardware, etc.

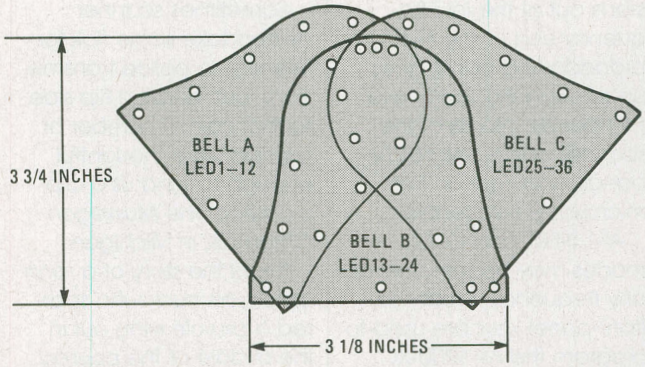


Fig. 2. The 36 LED's of the bell animation circuit are grouped by 12 and arranged to form three bell outlines. Here is the layout of the basic overlapping three-bell outline.

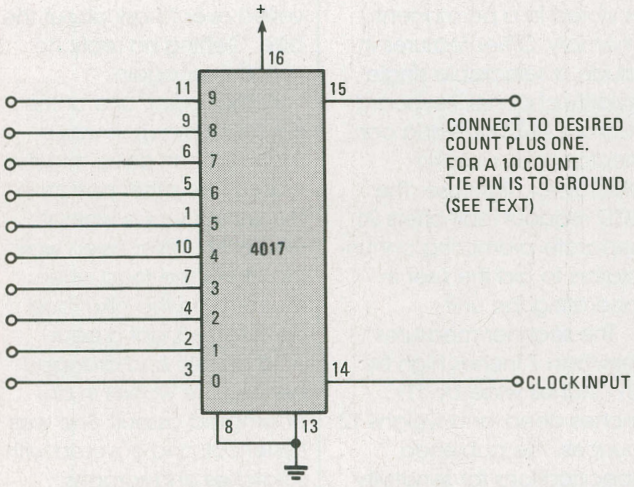


Fig. 3. Additional LED-bell outlines can be added to the circuit using this diagram as a guide. Simply connect pin 15 of the counter to the output that corresponds to the number of bells plus one. See the text for more information.

high, which in this instance is considered as the first output.) If you want to use all 10 of U2's outputs, tie pin 15 to ground. Of course, any increase in LED strings, must be accompanied by a corresponding increase in driver transistors. You can also use the basic circuit to animate other objects, such as a star, a ball, or even a Christmas tree.

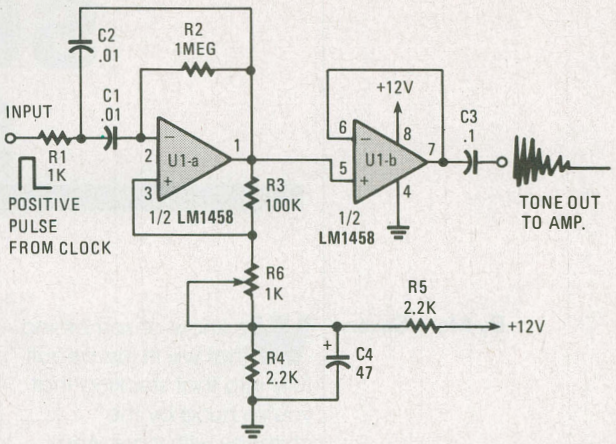


Fig. 4. The tone chime circuit shown here can be added to the animated bell to give the original circuit that extra flare.

PARTS LIST FOR THE MUSICAL CHIME

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—1000-ohm
R2—1-megohm
R3—100,000-ohm
R4, R5—2200-ohm
R6—1000-ohm potentiometer

CAPACITORS

C1, C2—.01-µF, ceramic-disc
C3—0.1-µF, ceramic-disc
C4—47-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

U1—LM1458 dual op-amp, integrated circuit
Perfboard materials, enclosure, IC socket, 12-volt power source, wire, solder, hardware, etc.

TONE CHIME

Our second circuit for this month is a simple add-on musical-chime. You can add the chime circuit to the animated bell circuit in Fig. 1 to jazz up the project, making the bell appear to ring as it swings.

In Fig. 4, half of an LM1458 dual op-amp (U1-a) is configured as a modified active filter whose gain is controlled by R6. If the gain is set too high the circuit will go into oscillation at the filter's resonant frequency. By adjusting the gain to just below the point of oscillation, the circuit can be triggered with a positive pulse, causing it to give out a short ringing signal at the filter's resonant frequency.

The chime-oscillator's output is buffered from external loading by the second op-amp, U1-b, which is configured as a voltage follower. The input of the chime-oscillator circuit can be activated by the output of the clock generator or any of the 4017's outputs in the animated bell circuit. Connect the chime's input to the desired trigger source and set R6 for a ringing output. The chime oscillator's frequency may be increased by lowering the values of C1 and C2, or decreased by increasing the values. ■

SCANNER SCENE

By Marc Saxon

To Catch a Thief

We know of something that will fit just beautifully into that stocking that you've hung by the chimney with care. And, when the family comes over to visit for the holidays, it will give you a good reason to hide in your room so you won't have to kiss Aunt Bertha.

It's the new ACE Communications handheld scanner known as the *AR-1000-XC*. Coverage? You want coverage? Try 1000 memory channels and a frequency range that begins at 500 kHz and goes straight through to 1300 MHz. No gaps in frequency coverage means that it starts out at the low-frequency end of the AM broadcasting band, goes up through the shortwave (HF) bands, into all of the scanner bands, the FM/TV bands, and right on into microwave frequencies.



Put the AR-1000-XC handheld scanner on your Christmas list if you want the gift of extensive coverage—1000 memory channels and a frequency coverage from 500 kHz right through the microwave frequencies.

AM, NFM, and WFM modes may be selected at any frequency. Twenty-six front-panel keys are used to program the AR-1000-XC. Pairs of upper and lower limits for bands to be searched can be stored in ten separate search-memory locations. All information is stored in a permanent memory. Other features include a selectable single priority channel, keyboard lockout, BNC antenna connector, and a backlit display for night use. The LCD readout itself offers 21 separate prompting annunciators to aid the user in operating the unit.

The scanner measures less than 7 inches high by 2½ inches wide by 1½ inches deep, and weighs 12 ounces. The published specifications for sensitivity are better than 0.35 μV at 12-dB Sinad in NFM mode, and 1.0-μV at 10-dB S/N in AM mode. The suggested retail price is $429, and that includes a 120 VAC-to-12 VDC adapter/charger, a DC cigarette-lighter plug/charger cord, a flexible antenna, a carrying case, and rechargeable batteries. For further information, contact Ace Communications, 10707 East 106th Street, Fishers, IN 46038.

SCORE ONE FOR SCANNER USERS

Sometimes scanner owners take some flak for listening to police transmissions, but there's a flip side to that coin. A number of readers were thoughtful enough to send us a clipping from the *Muskegon Chronicle*, in Michigan.

It told the story of a man driving his truck who spotted a bicycle lying out in the middle of the country road. When he stopped and got out to investigate, he thought he spotted a few teens hunched over in the nearby woods. He yelled over to ask about the bike. Getting no reply, he yelled over again.

At that point, one of the figures stood up. It was a man who ran deep into the woods. The other person in the woods was a woman, who had earlier been walking along the road when the man on the bike rode up, stopped, got a bear hold on her, and dragged her into the woods in an attempted assault. She was hysterical, and covered with scratches and scrapes.

Sheriff's deputies and police were immediately summoned, and a description of the suspect was broadcast over area agency radio systems. A police tracking dog was also put on the trail. Many residents in the area heard the sus-

pect's description on their scanners and came forward to report to police information concerning the suspect's direction of travel. He was captured after a chase. Sgt. Daniel Jacobsen, of the Muskegon Township Police, was quoted as stating, "If it hadn't been for citizens listening to their scanners, we probably wouldn't have caught him."

FREQUENCY FINDER

We enjoy finding frequencies for readers, but sometimes the requests that come in look to be geared to make it as difficult as possible for us to answer. For instance, Greg Pruitt of Alpharetta, GA wants to know the frequency of the Scottish Rite Hospital. Maybe if we were more familiar with the geography of Georgia, we'd have known that the hospital is an Atlanta facility. (Greg never mentioned that). We spent quite a bit of time attempting to run the place down in Alpharetta, without success. Finally, we located the hospital in Atlanta and found that it's licensed on 464.525 MHz, plus all of the MED channels between 463.00 and 463.125 MHz.

Next, Andy Peterson, Elburn, IL, hoped we could let him know the frequencies used by the State Youth Center Prison not far from his location, and also the frequency used by the high school he attends. Andy supplied a very detailed description of the radios used by the school personnel, but gave not one clue as to the name or location of either the school or the prison. Simply checking listings under the community of Elburn produced no likely candidates, so it looks like we drew a blank on Andy's requests simply because of insufficient information supplied as clues.

We don't need a lot, and we are anxious to help. But, please give us as much information as possible and don't assume that just because local information is second nature to you, we are able to fill in all of the blanks here at our end.

ALL AT SEA

Ship-to-shore (marine-operator) telephone calls can get interesting at times. In addition, those stations offer some good opportunities for seeing how many different stations you can copy from your location. The stations dot the North American coastlines, navigable rivers and inland waterways, and larger lakes. Most areas are within range of at least several of these stations, and some busy areas have stations using several different frequencies.

The warmer months cause these channels to become so jammed with stations that much of what you hear is total chaos. In the winter, though, the channels are still active and you get a much better chance to hear some of those distant operators, and to see how efficient your station is.

The channels used for ship-to-shore calls start at 161.80 MHz, and go up in 25-kHz steps to 162.00 MHz. Note that 162.025 MHz is used only in limited areas, including Puget Sound, the St. Lawrence Seaway, and the Great Lakes (except Lake Michigan).

SEE YOU NEXT YEAR!

Let me close for this month by wishing everyone a joyous holiday season and a happy New Year. Let's hear from you in the coming year! Send questions, ideas, frequencies, clippings, or whatever to *Scanner Scene*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

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SHIRT-POCKET RADIO

(Continued from page 36)

few buyers, and so any further technical development would be a wasted effort.

Radios this small also had a serious image problem. In the post-war years, Americans, finally freed of the great depression and the privations of wartime rationing and shortages, were not clamoring for downsized products of any kind; "big" was in. Adding to the shirt-pocket set's difficulties was its resemblance—in appearance and earphone-only operation—to late-forties' hearing aids. Few trendy adults would have been eager to embrace such a product.

Luckily that interpretation did not last. In fact, during the late 1950s, transistor shirt-pocket radios were selling annually by the millions; a mass market had finally materialized. Ironically, it was American teenagers who were putting these sets in their pockets (and purses) and earphones in their ears. The shirt-pocket radio became the badge of rock-and-roll's first generation. Long championed by youthful experimenters, the shirt-pocket radio had come home to young Americans. ■

SW/VHF CONVERTERS

(Continued from page 58)

or other source within the allowable range and dispense with the voltage regulator IC.

You can modify this circuit to operate in the low-band VHF region. First you must dispense with the local-oscillator components (C3, C4, and XTAL1) and use a 49-MHz TV-IF transformer with the capacitor crushed for T1. Then connect the voltage-tuned oscillator circuit shown in Fig. 6 to pin 6 on U1, leaving pin 7 of that chip unconnected. The oscillator circuit can be tuned over a wide range because it uses a "varactor diode" instead of a mechanical variable capacitor. A varactor is a diode that has a junction capacitance that is a function of the applied reverse bias voltage (which is derived from V_T). Any of several available varactor diodes can be used at VHF frequencies, including the NTE610 and the NTE614.

Frequency converters are often considered "magical art" circuits, but in reality they are quite simple. The guidelines in this article should be enough to help you design and build your own converters and take the mystery out of the "magic." ■

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THE MUSIC-ON-HOLD BOX

(Continued from page 55)

Press switch S1; the LED should light and stay lit until power is removed. The music will begin to play within two seconds of closing S1. Don't worry (if you are using a speaker) if the volume isn't loud enough to hear comfortably; the chip requires an additional transistor to drive a speaker. There will be ample drive power when the circuit is hooked to the phone line via the transformer. Reverse the power leads and verify that the circuit still works.

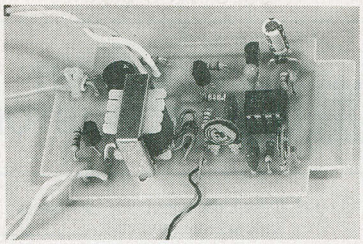
If the circuit does not operate as described, go back and recheck your work. If you get no sound or LED indication, check that placement of BR1 and D1. Be sure that they are properly oriented. If the LED lights, but you get no sound, verify that you've oriented all of the semiconductors, including U1, correctly. Check the setting of R5. If your LED is not lit, but you do have sound, swap the wires going to the LED.

Adjust the melody's tempo, using R5, as needed. Allow the tune to play all the way through. Once the entire melody has played, it will replay after a short delay. If that does not occur, be sure that the voltage at pin 8 of U1 is at a low state and that transistor Q2 is biased on only when the music finishes. Once everything checks out, remove the temporary power supply, and if necessary, the speaker, and shrink the tubing on LED1.

Connect a short length of modular cord (with modular plug) to the board; The green and red wires go to the pads marked G and R, respectively. Connect the phone and the project to the same phone line via a duplex adapter, Y-connector, or similar accessory. Suitable products are available from Radio Shack and elsewhere.

It's also possible to wire the circuit directly to the connector block where the phone line enters the room. The wires are color coded. This method is the most inexpensive way to hook up the circuit, but may require excessively long wire runs.

Verify that the circuit operates as expected when connected to the phone lines. If the circuit doesn't shut off when you pick up your handset after having been on hold, ground the gate of the SCR. If that solves the problem, reduce the value of R8 to 47 ohms or less. Resistor R1 could be also replaced with a 1k to 2k unit to lower the current through SCR1, thereby preventing excessive holding currents. Expect reduced brightness of the LED if that becomes necessary.



Install the transformer (T1) on the board with its center-tapped (3-wire) side facing U1. Then bend its mounting tabs inward toward each other, and solder all leads in place. Note that even though the center tap is not used, a pad is nonetheless provided for that lead.

As the volume of the circuit is increased, the load placed on the phone lines also increases. If you get unwanted oscillations in the music, increase the value of C5. The final setting of the volume and speed controls (R5 and R7) should be done with someone on the line. If after an honest effort, you can't get the circuit to work properly, send a self-addressed-stamped-envelope to Thumb Electronics (see address in Parts List), detailing your problem. All requests for assistance will be forwarded to the author. List the voltage readings at points G, R, around the SCR, and U1. Once the circuit is working completely to your satisfaction, drill the enclosure for the LED and switch.

Cut a 3/16-inch wide by 1/8-inch deep notch from the upper edge of the enclosure where the lid mounts. That provides passage for the wire going to the phone line. Since both potentiometers face the sides of the enclosure, it is possible to drill holes in the sides of the case to accept a screwdriver for external adjustments. You may wish to fasten the circuit to the side of your phone with velcro. If it is to be put on a table top, use rubber feet on the bottom of the enclosure to prevent scratching.

Other Possibilities. By examining the schematic diagram, it is easy to see how to use the circuit as either a hold circuit or music circuit. You could develop a circuit to have hold with no sound, or add music from a radio or tape player, so that your own taped special hold message or musical preference would be played.

The Music-On-Hold circuit is inexpensive, and easy to build and use. Once in service you will wonder "Why did I go this long without one?" ■

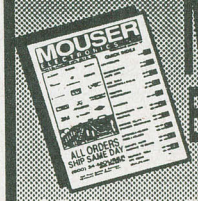
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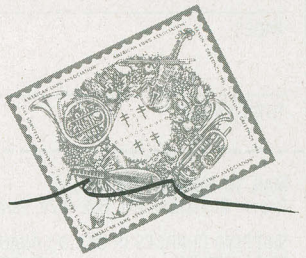
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THINK TANK

(Continued from page 22)

years and I noticed that we share an affection for simple but elegant circuits. Well, here's one that I came up with (see Fig. 7). It's a delay timer with *mucho* versatility.

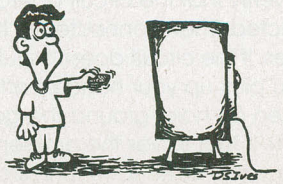
Both 556 sections are configured as monostable timers and are triggered simultaneously. Since both of their outputs go high when they are triggered, the optoisolator remains initially off. Assuming U1-b's period is set shorter than U1-a's, when U1-b times out it acts as a current sink while U1-a acts as a current source for the optoisolator, turning it on. The period of U1-b acts as a turn-on delay. The optoisolator will remain on until the remainder of U1-a's period passes.

You can use the circuit to control AC devices by replacing the transistor-output optoisolator with a MOC3010 Triac-driver optoisolator and a Triac. With a few modifications, this type of circuit can be used for many jobs. Think it's worth a book?

—Mike Houston, Ridgecrest, CA

I certainly do think it's worth a book. For those of you interested in using this circuit for AC-power control, replace the optoisolator with the circuit in Fig. 3.

Well, that takes care of another month. Remember, if you wish to participate in the fun, just write to *Think Tank*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■



"Oh No! The remote control is broken—now I'll never turn on the TV set."

CHOOSE A COMPUTER

(Continued from page 60)

All three were around $600 and you would have to spend another $600 for a printer. Floppy-disk drives with very limited capacity were available, but expensive, and hard-disk drives were beyond most pocketbooks.

Today you have, just in the IBM microcomputer world alone, the PC, XT, AT, 80386, 80486, and various models of the PS/1 and PS/2. Floppy-disk drives store from 360K to 1.44MB and hard drives go from 20MB to well over 100MB of storage. Memories go from 256K to 4MB, and beyond. Monitors include monochrome, CGA, EGA, and VGA (with some variations on each).

To add to the confusion are the enormous number of combinations of hardware—including many that refuse to work with each other. The most common lie told in the microcomputer world is "it's compatible." The facts are: most monitors will only work with certain video cards; disk drives (hard or soft) need controllers that mate with a drive's capacity and speed; 8088, 80286, 80386, and 80486 microprocessors are not the same, and require different BIOS's (Basic Input Output Systems). Furthermore, programs that work with one configuration absolutely refuse to work on another. This is only part of the compatibility trap.

Where To Buy. Fortunately, a very high percentage of these compatibility problems can be avoided by buying a complete assembled system—computer and monitor together with peripherals or add-on's like a printer, mouse, modem, etc.—from a single source. That will probably be more expensive than buying different things at the lowest price each, and then trying to make them work together. However, buying a complete system from one place eliminates squabbles with vendors as to whose equipment is causing you trouble.

If you're in a small town, your best bet is mail-order. Many computer magazines have page after page of ads offering complete systems, and all kinds of peripherals to add to existing systems. Many have toll-free phone numbers. While they can't tell you what you need, once you've determined your needs, you can inquire about price, delivery, guarantees, and support. Watch for traps like a 3% surcharge for credit cards or excessive shipping and handling charges. Once you know what you need, check with friends or associates to see who they bought from, and their degree of satisfaction.

If you're in a big town, computer stores, as mentioned earlier, will let you look and feel—but beware of sales hype. Your best defense is some homework. Look at the prices in computer magazine ads, so you have some idea of equipment costs, but expect to pay more at a store for their convenience and local support.

Short Cuts. There is a better way, but it may not be available to you. Find a "mentor"—a trusted, wise and faithful advisor, friend or teacher—who will take the time to help you with *your specific needs*. If your needs are fairly sophisticated and you're willing to pay, there are lots of consultants you could hire as well.

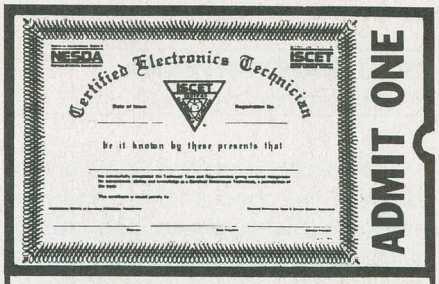
Perhaps the best way to find both is to go to some local user-group meetings and ask questions. You can usually find information about user groups from computer stores, computer magazines, and local newspapers.

The Time Trap. You will have a natural tendency to put off the buying decision due to your uncertainty, and dropping prices. Also, you may be waiting for the next wonderful breakthrough just over the horizon. Don't let yourself get into a mirage mentality.

Get some facts, make a decision, make conservative purchases, learn by doing, and then upgrade to what you really need as time goes by. You will probably never find out what you really need by research, only by experience. And (of all horrors) you might find all you really need is some 3 × 5 index cards and a typewriter! ■



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DUAL BAND ANTENNA

(Continued from page 63)

The hula hoop may be slightly undersized for the conduit fittings and may need to be shimmed. The author wrapped 10-mm copper strips around the tin foil to make up the difference.

After affixing the shielded hoop to the enclosure, it's time to wind the loops. To begin, pass one turn of wire through one end of the hoop, returning to the enclosure through the other end. That wire loop is for 80/75-meter operation. Note that neither the size nor type of wire that is used is critical. For example, I used 18-gauge speaker wire in my prototype.

Connect one end of the antenna wire to the junction of C1 and C2 and the other end to the center (wiper) contact of S1. Feed two more turns of antenna wire through the hoop. One end of that double loop of wire will be connected to ground and the other end goes to one of S1's contacts; the switch's remaining contact is tied to ground. The second loop is for 160-meter operation. Remove about 1-inch of the foil shielding from top dead center of the hoop to allow signal reception, while preventing the hoop shielding from acting as a shorted turn to the desired electromagnetic field.

Assemble the rest of the circuit using Fig. 1 as a guide. In the author's prototype, all of the other components—except S1, S2, B1, J1, and C1 (it's too big)—were placed on a terminal strip that was mounted (with one or two of its lugs grounded) to an inside wall of the enclosure. Point-to-point wiring was used to interconnect the components. You could also assemble the circuit on perfboard, if you prefer.

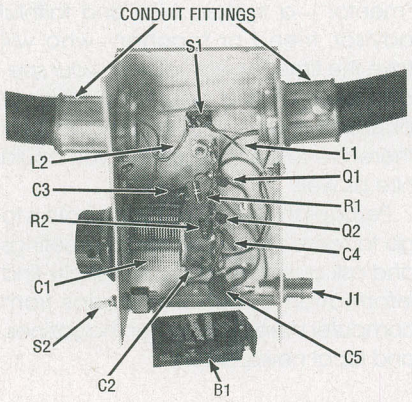
In any event, keep all lead connections as short as possible. Note that, although 2N3904 transistors are used in the schematic diagram and an alternate unit is listed along with the aforementioned transistor in the Parts List, the transistors are not critical; any general-purpose NPN transistor can be used in the circuit.

Once the circuit is complete, check your work for possible wiring errors; misconnected components, short circuits, etc. When that's done, mount the assembly to a piece of wood, which will serve as a stabilizing base. The author used a 1- × 12- × 12-inch piece of wood (which he just happened to have laying around).

Operation. The operation of the Dual-Band Loop Antenna is very simple. Connect it to the antenna jack of your receiver or to your transceiver's auxiliary-antenna jack. In the event that your transceiver does not have an auxiliary-antenna jack, you'll have to build some type of antenna-switching arrangement before using the project.

Warning: Whatever you do, *do not* transmit using this antenna; doing so will destroy the transistors in the preamp.

Apply power to the circuit by closing S2; then set S1 to 80 meters. Adjust C1 until the noise level peaks. You should



Here is an inside view of the Dual-Band Loop Antenna. Note that the entire circuit, except for S1, S2, C1, B1, and J1, was assembled on a terminal strip.

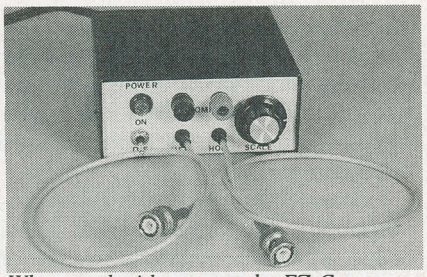
now be able to hear signals by tuning around the band. If you detect any power-line or other noise, rotate the loop until you find a null in the noise. Be sure to take your time as the null will be very sharp. In some cases, the noise can be reduced from an S9 to S0.

The loop can also be used to reduce the effects of extremely strong signals from local amateur installations. In addition, the loop can be used to lessen the high QRN from thunderstorms. By rotating it away from the direction of the storm, the QRN level is lowered several S-units, which may make the difference between a good copy and no copy at all.

The loop does have its limitations. If there is more than one source of noise, the loop will not be effective. When using the loop on 160 meters, you may have several false peaks when adjusting C1. The correct setting is determined experimentally. The correct peak will be obvious. But with incorrect settings, you will hear all kinds of broadcast garbage. ■

SIGNATURE TRACER

(Continued from page 28)



When used with a scope the EZ-Curve Signature Tracer can diagnose the condition of a variety of components.

C or L, involves using one of two different equations.

The easiest procedure to follow, which reduces the math to a minimum, is to take a reading or two, do some math to find a value, perhaps take another reading, and use your previous results to find yet another quantity. With that in mind, the first thing you should do is measure the maximum current (denoted I_{MAX}) and the maximum voltage (denoted V_{MAX}) on the scope. Note that the maximum current and voltage do not occur at the same point on the curve. From the two readings you can determine the impedance:

$$Z = V_{MAX}/I_{MAX}$$

Next, measure the current at which the curve crosses the vertical axis (I_Y). You can use that measurement and the value you got for Z to find the reactance:

$$X = Z \times I_Y/I_{MAX}$$

From the reactance and the impedance you can find the value of the component's internal resistance:

$$R = \sqrt{Z^2 - X^2}$$

From X and R you can determine the device's Q factor:

$$Q = X/R$$

You can also find the value using this equation for an inductor:

$$L = X/(180\pi)$$

or this equation for a capacitor:

$$C = 1/(180\pi X)$$

That's a lot of data from three points on a curve!

We're sure that you'll find the EZ-Curve to be a very useful device. But even if your scope already has a component checker, you now know exactly how that feature works and how to take full advantage of it. ■

quency of the swept region to be set by a 10k potentiometer, while the sweep width is set by the sawtooth amplitude.

One of the problems with a varactor-tuned oscillator is that the relationship between voltage and frequency is nonlinear. A somewhat improved version of the tuned circuit is shown in Fig. 4. In that variation of the V_t input, a pair of identical varactors (D1 and D3) are connected cathode-to-cathode. That circuit is more linear (hence is more suitable) for spectrum analyzer and panadapter circuits.

However, the capacitance seen by L1 is one-half the capacitance of either diode alone. That phenomenon occurs because the coil effectively sees two identical capacitors in series, so the total capacitance is half of either unit.

The circuit in Fig. 4 also serves as a decent radio receiver, especially if you provide an audio amplifier to follow the detector. An LM386 low-power audio amplifier should do for that.

Ramsey Electronics (793 Canning Parkway, Victor, NY, 14564; Tel. 716-924-4560) offers low-cost, varactor-tuned, NE602/LM386 receiver kits. They can be modified to make a panadapter or spectrum analyzer that operates within the tuning range of the kits. I've built one and reported on it in this column previously. I also modified it by adding a sawtooth to the tuning voltage, making it into a sweep receiver.

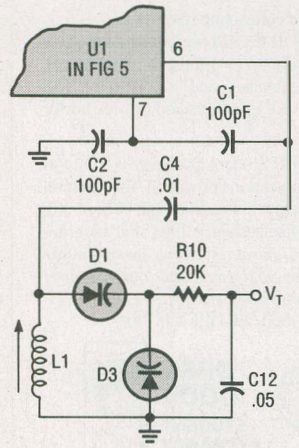
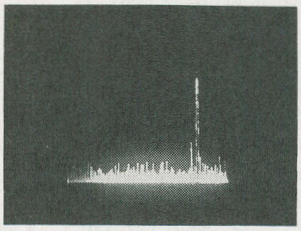
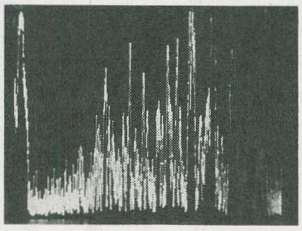


Fig. 4. Using this circuit as the V_t input to the spectrum analyzer results in more linear tuning for the circuit.



The signal shown here is that of a child's CB walkie talkie.



Here's a segment of the HF spectrum from about 40-meters to a little higher than the 20-meter band taken in the evening with all bands open.

One thing that voltage tuning of a receiver or spectrum analyzer offers is the potential for computer-driven tuning. If you use a voltage output digital-to-analog converter (DAC), it is possible to use an eight-bit binary word from a computer port to drive the tuning of the receiver/analyzer to a desired frequency.

Note: Most signal generators do not have a sawtooth output. Also, many of the published circuits produce a poor sawtooth. I have a circuit for a digitally controlled sawtooth generator. Send an SASE for a free copy of the schematic to c/o *Ham Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■

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ICONtroller

(Continued from page 62)

hesive strip holds the ICONtroller solidly to the side of the keyboard. If you should later decide to remove this adhesive strip, it comes off without leaving a residue.

The laptop version uses a short 1-foot coiled cable and locking adhesive pads. These separable plastic pads have hundreds of tiny molded hooks that mesh together and hold much more tightly and firmly than Velcro, since any sponginess would interfere with ICONtroller action. The pads are pre-cut to the proper shape, and three are supplied to use the ICONtroller with two machines, such as a laptop and a desktop. Since a desktop would require a longer cord to reach the RS-232 port (usually at the back of the computer), a 5.5-foot extension cable is included, with 9-pin connectors on each end. This version also comes with a carrying case for easy travel.

Regardless of the version, should the ICONtroller need support to match the height of your keyboard, an adjustable screw-in foot is provided.

Using the ICONtroller. Once connected, you'll need a mouse driver to use the ICONtroller. This is either a separate driver, or may be included in your application program, such as Windows 3.0. If you have a Microsoft or Mouse Systems driver program, it will work with the ICONtroller. If you don't, included in the ICONtroller package are both 3.5-inch and 5.25-inch diskettes with a Microsoft-compatible mouse driver called ICN.COM, as well as a tutorial demonstration program.

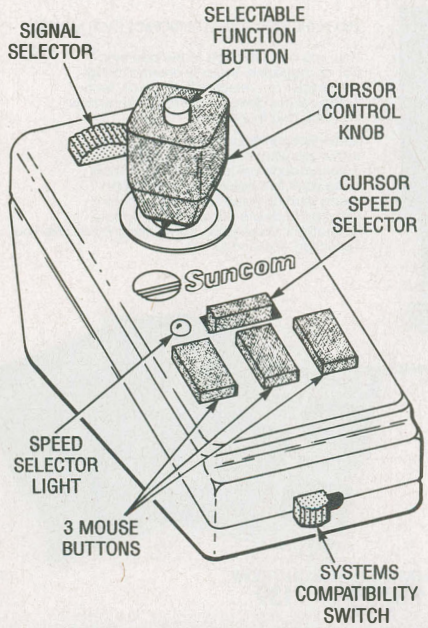


Fig. 1. The ICONtroller has several unique features that make it versatile and easy to use.

At first it's a good idea to run Suncom's SETUP program, which uses both pictures and text to take you through all the ICONtroller features, and gives you some practice. Actually, SETUP is poorly named, since you do not have to run this program to use the ICONtroller. It should be called DEMO or TUTOR. However, you'll need a graphics display adapter (Hercules, CGA, EGA, or VGA) to run SETUP.

I tested the ICONtroller with a variety of programs that normally use a mouse or trackball. Using just one finger I was able to easily and quickly manipulate the screen cursor in Windows 3.0 and GeoWorks Ensemble, two programs that absolutely require a pointing device. Although the sensitivity and two-speed action of the ICONtroller take some getting used to, I found it comfortable after only a little orientation.

There is virtually no substitute for the ICONtroller in using a laptop away from a desk or table. If you have been not been using Windows or GeoWorks with your laptop because of the lack of a pointer, your problem is solved.

Although the ICONtroller does not allow movement except in eight directions, there are some advantages to this. It is very easy to move horizontally and vertically without wandering off track. I found no compatibility problem with any program that accepts a mouse.

If you are happy with a mouse or trackball without ballistic control, and have the space for them, the ICONtroller can still offer you its two-step speed function. Furthermore, it doesn't wander like a mouse. Also if you have a laptop that you normally use on your lap, with no operating space for a mouse or trackball, the ICONtroller stuck to the side of your keyboard can open up new vistas for you.

The "desktop" version of the ICONtroller has a suggested retail price of $84.99, and comes with everything you need, including software. The "laptop" version, sells for $99.95. For more information on either model, contact Suncom Technologies (6400 W. Gross Point Rd., Niles, IL 60648; Tel. 1-708-647-4040) or circle number 119 on the Free Information Card. ■



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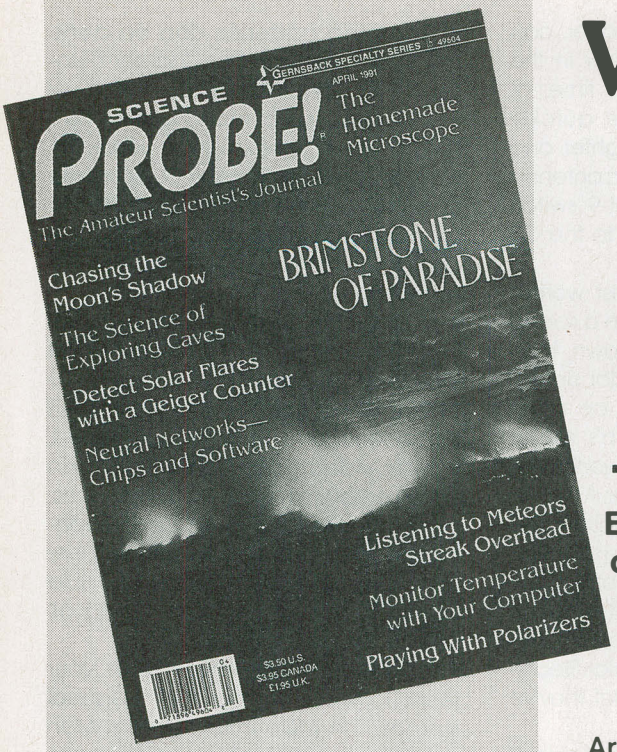
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HOLIDAY GIFT GUIDE

(Continued from page 34)

up until you've listened through all seven tapes! The multi- and single-play, auto-reverse cassette changer accommodates six cassettes in deck one and one cassette in deck two. It's equipped with Dolby HX Pro as well as Pioneer's CD-deck synchro function for continuous taping. It seems ideal for your next family party.

It's difficult—and expensive—to try to provide good sound in every room in the house. But not if you can move that sound around from room to room. That's just what the *Acoustic Wave Series II Music System* (Bose, $997) lets you do. The sleek, one-piece unit, which proves that big sound *can* come in small packages, provides AM and FM radio, equalization, amplification, loudspeakers, and a CD player. An optional case, power pack, and power cord make it completely portable for use outdoors or in a car or van.

If you love your current stereo system, but the speakers are getting in the way of your wife's interior-design plans, perhaps a new set of speakers could make a good gift for you both. The *Heco Libero* satellite/subwoofer system (EuroSon, $599) takes up much less space than standard speakers without sacrificing sound quality. The trick is that the low frequencies are reproduced by a single subwoofer, which can be stored out of the way—even under a chair. The higher frequencies are reproduced by the small, two-way "satellite" speakers. The setup works, and sounds good, because our ears are very poor at locating the source of low-frequency sounds—all of our directional cues come from higher frequencies.

Anyone who drives alone (particularly at night, or in unfamiliar areas, or in a less-than-reliable car) is uncomfortably aware of the dangers of a breakdown. Cellular telephones provide emergency communications without leaving the relative safety of the automobile—but the monthly service charges can be prohibitive, especially if the phone is only used occasionally. The *S.O.S. model 39 PLUS* portable CB radio (Cobra, $89.95) provides the security of two-way communications at a reasonable price. Although it is a full-function citizen-band radio (40-channels, electronic digital tuning, large LED channel display), those who are interested in it primarily as a safety device, and not for on-the-road chatter, can keep it stored under a seat or in the trunk when it's not needed. In times of distress, the S.O.S. can be quickly plugged into the cigarette lighter, and a magnetic-mount telescopic antenna set up. The Instant Channel-9 switch provides immediate access to the CB emergency channel.

If someone on your gift list worries more about getting caught in a speed trap than about breaking down, then the *Solar Stealth RD-6000* radar detector (Cobra, $319.95) should be more than welcome. The Stealth's major claim to fame is that it's the world's first solar-powered radar detector. A built-in solar panel keeps the internal batteries charged. To keep power drain to a minimum, a built-in motion detector automatically shuts off the unit when it detects no motion for three minutes. Cobra also claims that the Solar Stealth is the least detectable model they've ever produced.

There are those, of course, who don't care about breakdowns or getting speeding tickets as long as their car is equipped with a great audio system. For them, there's the model *7915* in-dash FM/AM compact-disc player (Alpine, $520). The 8-times oversampling CD player offers Alpne's "Hybrid IDAC" D/A conversion system. The tuner offers some interesting features, including the ability to store both AM and FM presets on the same band, and an automatic memory mode that stores the 6 strongest stations. The amplifier offers "source tone memory," which memorizes the bass and treble settings for each source (FM, AM, and CD). Dual pre-amp outputs make it easy to set up and expand the system.

For the exercise-crazy member of your family, consider the *Pulse Meter* wristwatch. (Sanyo, $129.95). For accurate readings, even during heavy exercise, the Pulse Meter uses a chest sensor, which is held in place by an adjustable elastic strap. Signals from the sensor are sent to the wristwatch by RF signals—no cumbersome wires are needed. A pulse-rate memory stores maximum, average, and minimum heart rates. An alarm can be set to ring if the heart rates exceeds or falls below preset limits.

Electronic Stocking Stuffers. Here are some items that are perfect for grab-bags or stocking stuffers, or for the paperboy or babysitter—all are priced under $20:

- Charging batteries can be done anywhere with the *SlimCharger* (Panasonic Industrial Company, $14.95 or $19.95 with a set of rechargeable batteries). The charger weighs less than 3½ ounces, is about the size of an audio cassette, features a flip-out plug, and fits easily in a pocket or purse. It will charge four AA or AAA rechargeable batteries in six hours.
- Audio cassettes remain the best-selling music format, so a "Buy Five, Get One Free" six-pack of *Ferro Extra C90's* (BASF, $4.99) makes a good (and thrifty) gift for teens and other frequent tapers.
- Dirty video-game cartridges can cause problems such as power flashes, blank screens, and scrambled graphics. The *Ninja Game Cartridge Cleaner* (Technitron, $7.95) comes with a liquid cleaner and swabs for cleaning all brands of video games.
- If you can't remember what your teens look like without their personal stereos, the *Millennium ChargeMan RapidCharger* (Gates Energy Products, $14.95) belongs in their stockings. The pocket-sized three-hour charger includes two AA Millennium Power Cells and a rebate offer for two free back-up cells.
- Static electricity can damage computers, office equipment, home-entertainment components, and appliances—and so can dust and dirt. *StatX* spray cleaner's (RTW, $7.99) dual-action formula cleans electronic gear while protecting it from static buildup.
- The *Slotless CD Organizer* (Allsop $9.95) makes it easy to add a new disc to your alphabetized CD collection without having to move each one, slot by slot. Spring-loaded retention fingers hold single discs or multiple-disc sets securely, yet allow sliding movement of one or several discs at a time. Each stackable unit holds up to 25 CD's.
- Print out a computer-generated "Happy Holidays!" banner on *Banner Band* continuous, nonperforated paper, and you won't have to worry about it tearing down the middle when you hang it up. The paper comes in white, parchment, assorted pastel and fluorescent colors, and with borders or all-over designs, in 45- and 150-foot lengths.

Happy Holidays! So get out there and hit the electronics stores *before* the holiday mob scene. Then relax, put up your feet, and enjoy a glass of eggnog. Happy holidays from **Popular Electronics**! ■

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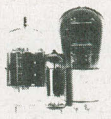
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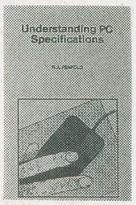
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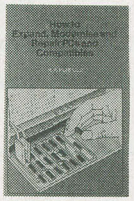
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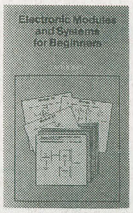
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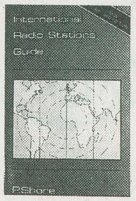
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FLASHING LAPEL PIN

(Continued from page 61)

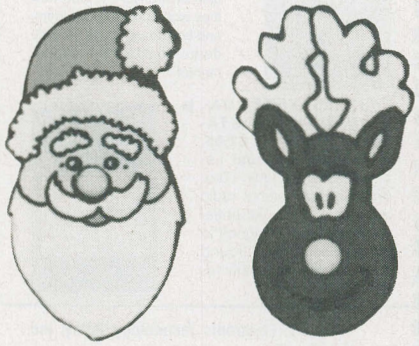


Fig. 2. Shown here are two full-size templates of the faces used by the author. Each has a 3/16-inch hole in the nose, through which the LED will protrude.

hold the stick pin. The non-pointed end of the pin should line up with the ends of the "U" loop and be parallel with them. Optionally, you can bend the non-pointed end of the stick pin into a loop as shown. Doing so helps to hold the battery in place.

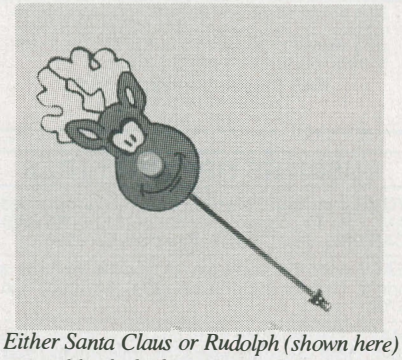
Next fill the space between the base of the LED and the stick pin with glue (see Fig. 1C) covering the solder and the base. Before the glue dries, pinch the end of the pin and the ends of the U-loop together so that the non-pointed end of the pin is between both ends of the U-loop and on the same plane.

PARTS AND MATERIALS LIST FOR THE FLASHING LAPEL PIN

2.5-volt blinking red LED (Radio Shack 276-036, Jameco part #XC5410, or equivalent)
3-volt lithium battery (type DL1620 or DL2016)
Chrismas face (see text)
Standard paper clip
Stick pin
Glue (hot or epoxy)

Note: Die-cut, color-print Santa Claus and Rudolph faces are available for $0.25 each, plus $1.00 postage and handling per order from J.B. Gizmo, Box 1084, Jones OK, 73049. Oklahoma residents please add appropriate sales tax.

Blinking LED's are available from Radio Shack as part #276-036 and Jameco Electronics (1355 Shoreway Road, Belmont, CA 94002) as part #XC5410



Either Santa Claus or Rudolph (shown here) can add a light-hearted touch to your holiday fun.

That tapering gives the pin enough "spring" to hold the battery tightly between the pin and the U-loop after the glue dries.

Finally, photocopy the templates in Fig. 2, color and cut them out, punch a 3/16-inch hole in the nose and push over the LED. You may want to reinforce the paper cut outs by laminating them between two sheets of contact paper, or you may want to draw them directly on a heavier stock of paper, either way will work fine. Die cut, full color artwork is also available from the source in the Parts List. Put the battery between the pin and the U-loop and you're done. ■

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The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

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The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

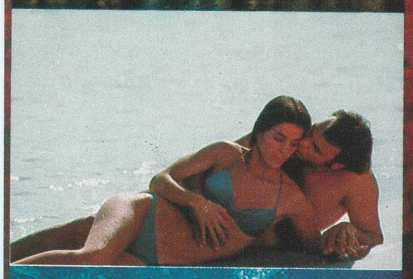
This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

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